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THE DEVELOPMENT OF A RECONSTRUCTION-FORM TACTUAL TEST

FOR USE WITH THE ADULT BLIND

A Thesis

Submitted to the Faculty

of

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by

Alin Gruber

In Partial Fulfillment of the

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Complies with the University regulations and that it meets the accepted standards of the Graduate School with respect to originality and quality

For the degree of:

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Signed by the final examining committee:

Joseph Tiffin, chairman

Approved by the head of school or department:

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Joseph Tiffin
Professor in charge of the thesis

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AG

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ABSTRACT

Gruber, Alin. Ph.D., Purdue University, May 1959. The Development of a Reconstruction-Form Tactual Test for Use with the Adult Blind. Major Professor: Dr. Joseph Tiffin. 97 pages, 14 tables, 8 figures, 33 titles in the bibliography, 5 appendices. A research problem in the development of a special ability test to assist in the prediction of vocational success with the adult blind.

The purpose of the research was to develop a special ability test which would yield a combined measure of both tactual perceptiveness and gross manipulative dexterity. The test was to be applicable for use with the legally blind, including both those persons who are totally blind and those who still possess partial vision in the better eye or in both eyes. It was desired that the test be of assistance in vocational selection, placement and counseling, especially with regard to the many occupations which require the blind to use their hands in earning a livelihood.

A special ability test for use with the adult blind was constructed using a pegboard format. The test was designed to yield a combined measure of tactual perceptiveness and gross manipulative dexterity. Examinees were required to reconstruct six items, which were composed of patterns or configurations of pegs, as accurately and quickly as possible. The test was administered to 318 legally blind subjects who were between the ages of 20 - 50 and who had no other major handicap in

addition to blindness. In taking the test, subjects were allowed to use whatever residual vision they possessed. Performance on the test was scored on the basis of logical considerations, and this resulted in a total index score combining accuracy of reconstruction, correctness of location, and time required for reconstruction, for each item.

A distribution of total index scores for the entire sample showed that scores on the test tend to be distributed in an approximately normal manner. The relative difficulty of the items was estimated from the mean and standard deviation for each item as determined from the entire sample, and this evidenced that the test items had been presented to subjects in a general order of increasing difficulty.

The estimate of the internal consistency reliability of the test scores for the entire sample yielded an obtained coefficient of $r = .93$, using Hoyt's analysis of variance method for computing reliability. The obtained estimates of the validity of the test scores were $r = .58$ and $r = .47$ between the outside employed ($N = 84$) and the unemployed ($N = 34$) criterion groups and between the outside employed and the shop employed ($N = 105$) criterion groups, respectively. Scores on the test did not differentiate between the shop employed and the unemployed criterion groups. The estimate of the validity of the test scores with ratings on a sample of shop employed blind from Chicago ($N = 32$) was $r = .54$. For another sample of shop employed blind from St. Louis ($N = 52$), the obtained estimate of the validity of the test scores with ratings was $r = .46$.

The relationship between remaining vision and scores on the test yielded an obtained estimate of $r = .39$, based on the data from 314 subjects. The magnitude of the relationship between vision with scores on the test was not considered excessive in view of the obtained estimates of the reliability and validity of the test scores for the sample and various sub-groups. Data are presented that indicate that remaining vision was related to and/or contributed to the systematic variance of some of the criteria of vocational success that were used. An observation is also discussed which suggests that several of the test items possibly reveal the presence of a perceptual disorder and/or brain damage, i.e., several subjects could reconstruct certain items only in a mirror-image or inverted form.

A principal components factor analysis was performed to investigate the theoretical structure of the reconstruction test. Included in the intercorrelation matrix were two part scores representing pure manipulative dexterity and two subtests of the WAIS verbal section. The factor analysis resulted in a single factor accounting for the systematic variance among the items of the reconstruction test. This single factor was a common factor which was composed of both tactual manipulative dexterity and tactual and/or general perceptiveness.

The following conclusions were made regarding scores on the reconstruction test for the sample of the blind population tested: (1) the test scores are reliable and have demonstrated validity to a useful extent; (2) the test scores do yield a combined measure of both gross manipulative dexterity and tactual perceptiveness. It is felt that the

tactual reconstruction pegboard should prove of assistance in the vocational selection, placement and counseling of the adult blind.

FOREWORD

The research reported in this thesis was performed as part of a larger research effort under a grant from the Office of Vocational Rehabilitation, Department of Health, Education and Welfare. The research award was made to the Purdue University Research Foundation and under the direction of Dr. Joseph Tiffin.

The research project, entitled, "An Investigation of Vocational Success with the Blind", was initiated in June of 1957 as a three year continuing study. The specific purposes of the project:

(1) the development of "tailored" aptitude and personality tests which can demonstrate validity against available indices of employment success;

(2) the investigation of the general effects and problems of legal blindness as it affects employment level and success.

THE DEVELOPMENT OF A RECONSTRUCTION-FORM TACTUAL TEST FOR USE WITH THE ADULT BLIND

> The answers to many of the psychological problems of blindness possibly cannot be determined until measuring devices are developed that will give results not materially affected by the absence of the major sense modality of sight. Adaptation of existing tests and the establishment of suitable norms for them may be possible in some instances ... Perhaps the better solution in many instances will be to use instruments especially designed for the nonseeing. Tests are needed which will make available the same information regarding basic psychological factors, such as perception, spatial orientation, verbal and nonverbal abilities, and reasoning, as can now be obtained for seeing people...
>
> In general, the objective of research in relation to psychological tests and measurements for the blind is to develop or adapt tests of mental abilities, interests, personality traits, achievements, and special aptitudes such as motor dexterities and music aptitude (Nat. Psychol. Research Council for the Blind, p. 7).

The above statements, from a publication by the Office of Vocational Rehabilitation, Department of Health, Education and Welfare, indicate the desirability of psychological tests designed specifically for use with the blind. The utility of psychological tests is recognized, and the requirement is for instruments to assist in the measurement of abilities possessed and to aid in the prediction of vocational success. The tests suggested above include the perceptual and the psychomotor ability tests.

Among the types of perceptual tests are those which measure the ability to recognize the relations within a form, or the ability to reason about or between forms. Such tests are sometimes referred to

or grouped with spatial ability tests (Cronbach, 1949) in that the person being tested is required to perceive relationships that exist or are defined in space. The problems presented by such tests may be of either two-dimensional or three-dimensional form, and they may require either a mental or physical manipulation of the form as a necessary step to a solution. Many tests referred to as mechanical ability tests involve, at least in part, this spatial or perceptual ability (Harrell, 1940).

Psychomotor tests are those which measure the speed and coordination of muscular abilities, or "combinations of sensory and muscular abilities" (Tiffin & McCormick, 1958, p. 134). This type of psychological test includes instruments measuring dexterity, manipulative ability, motor ability, eye-hand coordination, et cetera.

Both the perceptual tests and the psychomotor tests may be grouped under the common classification of special ability or special aptitude tests (Anastasi, 1954; Cronbach, 1949). The term "special" is used to differentiate these tests from the intelligence and/or general ability tests which measure to a limited extent, if at all, abilities similar to those assessed by special ability tests. It is due to this fact, i.e., that the general intelligence tests do not measure certain psychological abilities, that tests of special abilities have been developed to assist in the problems of vocational selection, placement and counseling.

There is ample evidence in published psychological literature that special ability tests can meaningfully serve the needs of vocational

selection and counseling (Anastasi, 1954; Bennett & Cruickshank, 1942; Bingham, 1937; Cronbach, 1949; Long & Lawshe, 1947; Super, 1949; Tiffin & Asher, 1948; Tiffin & McCormick, 1958). Among the occupations in which special ability tests have made a significant contribution are those in which people earn a livelihood through the use of their hands. There is a variety of such tests available, at least for use with the sighted.

The fact that there is a variety of special ability tests, which have demonstrated validity for occupations involving use of the hands, indicates that the type of manual ability required differs among jobs and occupations. Some jobs involve simple manual operations which are repeated over and over. Other jobs require a combination of complex manual operations. Still others demand a manual versatility or adaptability so that a worker can be shifted to a variety of jobs as the demands of the manufacturing schedule change. For jobs demanding manual versatility, superior initial ability is perhaps of prime importance, as there is usually insufficient time for a worker to reach his maximum level of proficiency before being transferred to a new task. Superior initial ability is also of importance in those manual occupations in which a new worker might damage costly tools and materials or do injury to himself by accident. In the case of operations that will be repeated over a long period of time, it is the maximum level of proficiency that a worker's ability will allow him to achieve that is important. However, in connection with this last statement, it should be mentioned that in so far as the training or experience tends to increase individual

differences, a high initial ability is still desirable. Tiffin and McCormick (1958) have concluded, from an analysis of research regarding training and its effect upon individual differences, that it is in the complex tasks and jobs that training tends to increase individual differences. For the simple, routine jobs, which include those involving simple manual operations, training generally results in a decrease in the magnitude of individual differences; however, "training seldom changes the relative standing of individuals in their ability to perform any given task" (Tiffin & McCormick, 1958, p. 23). Further, as superior initial ability will generally reduce training time and/or the time required for a worker to achieve his maximum level of proficiency, superior ability is desirable for those jobs involving simple manual operations.

With regard to the validity of special ability tests, there are at least the following two aspects associated with the concurrent and predictive validity of such instruments: (1) the tests identify those people who possess a greater amount of the ability being measured; (2) those who possess this greater amount are presently or later become those workers considered vocationally better when compared with a criterion of job success. Concerning those special ability tests that yield a relatively pure measure of manual ability or dexterity, the reported validity coefficients generally do not exceed the magnitude of approximately .45 (Anastasi, 1954; Bennett & Cruickshank, 1942; Bingham, 1937; Cronbach, 1949; Long & Lawshe, 1947; Super, 1949; Tiffin & Asher, 1948; Tiffin & McCormick, 1958). This fact is understandable since jobs

involving manual ability require more than manual ability alone for a person to be considered a good worker. In other words, manual ability tests, while predicting a useful portion of the criterion of job success, do not predict or overlap the entire criterion, i.e., job success is not unifactorial. There are generally two courses of action that can be taken in an attempt to predict a larger portion of the criterion variance: (1) combine, with the test of manual ability, other tests that will account for a portion of the remaining criterion variance; (2) adapt or tailor-make a single test which will by itself predict a larger portion of the criterion variance. The second alternative is not always feasible, and it implies a multifactorial type of test. Further, the multifactorial test is not always desirable in the sense that one might want a pure measure of manual ability. Nevertheless, one way to increase test validity is to measure more than one of the several abilities that may be related to job success.

Special Ability Tests and the Blind. The published literature regarding special ability tests for use with the blind is relatively sparse. There have been seemingly few attempts to adapt or develop tests of special abilities for such people. This situation is in contrast to the apparent, and in some respects unique, problems of vocational selection, placement, counseling and rehabilitation associated with the nonsighted.

The state of affairs described above includes the status of manual ability tests for use with the blind; yet, one characteristic of a majority of the occupations filled by blind workers is use of the hands.

Even a brief survey of the jobs performed by the nonsighted in typical industrial settings and blind agency or sheltered workshops (workshops employing only the blind and adapted for their needs) demonstrates how extensively the blind are required to make use of their hands in earning a livelihood (Handbook of Representative Industrial Jobs for Blind Workers).

Bauman (1946) reports the results of the adaptation of several psychological tests suitable for measuring abilities used by blind persons in industrial jobs. The tests adapted were the Minnesota Rate of Manipulation, the Pennsylvania Bi-Manual Worksample, and the Toolsample. All three yield measures of manual or manipulative dexterity. The modified Minnesota Rate of Manipulation is described as follows (DiMichael, 1947, p. 7):

> The first part in the changed version is called the displacing test. It consists of 59 wooden cubes in the 60 holes on the board. The task is to move each cube to an empty hole. The final score represents speed of gross one-hand manipulation and accuracy of orientation in the workspace... The second part is the turning test. The subject is required to pick-up, turn-around, and replace each cube in its respective hole. This demands mainly a speedy and smooth coordination of gross finger and hand movements. The new directions call for three trials for the blind whereas only one is required for the sighted.

The Pennsylvania Bi-Manual Worksample has two subtests also: assembly and disassembly.

> The subject puts together 100 sets of nuts and bolts and inserts each set into a hole on an 8- by 24-inch board; then the operation is reversed... The test involves speed of arm, hand, and finger coordination (DiMichael, 1947, pp. 7-8).

In the Toolsample, "various kinds of nuts and bolts are removed from one board and tightened in another with the aid of tools" (Bauman, 1946,

p. 145). These instruments were administered to a total sample of 312 legally blind persons of differing age, age at the onset of blindness, and degree of legal blindness. Normative data, in terms of standard scores, are presented for the three instruments on the sample stratified according to several degrees of legal blindness. No reliability or validity data as such are reported. Data were also obtained on a sample of 19 blind persons who were successfully employed in industry. The performance of this last group on the three instruments became the criterion recommended for use in placing blind persons with the assistance of the tests. Bauman (1946) also reports the attempt to adapt the O'Connor Finger Dexterity Test, the Purdue Pegboard, and an object sorting and assembly test. The first two (O'Connor and Purdue) were discarded because, while providing "useful information in the cases of persons having better than light perception, (they) required too accurate orientation in space for our totally blind clients" (Bauman, 1946, p. 12). The object sorting and assembly test was discarded because blind persons who were successfully employed in industry and who made good scores on the three instruments discussed above "could not make scores within the normal range of seeing persons on this exercise despite additional practice ... (and) we were forced to conclude that vision gave advantages in the performance of this task which could not be overcome ..." (Bauman, 1946, p. 146).

Some comment would seem in order regarding Bauman's reason for discarding the test of object sorting and assembly. It is true that the format of many special ability tests currently available for use with the sighted makes them inappropriate for use with the blind — to use

them would yield biased and perhaps meaningless results with regard to the ability being measured. It is also true that one will not convince industry of the advantages of hiring the blind by showing that blind workers perform less ably than sighted workers on a particular test. The latter fact alone, however, does not mean that a test can not be of value for use with the blind. One obvious fact stemming from such a test is that blind workers should not be assigned to compete with sighted workers on a job for which, due to the nature of the job or the way in which operations are currently being performed, there is a high predictive validity between scores on the test and job success. In all probability, there are other jobs for which the same instrument, or some modification thereof, can be of use in placing a blind worker, assuming that the instrument reliably differentiates people in terms of the ability measured. Further, as mentioned earlier, job success is seldom unifactorial, and chances are low that the predictive validity between a single measured ability and job success is very high. In such a case, this same test, on which blind people as a group perform less ably than the sighted, can be of use to a rehabilitation or vocational counselor who has been requested to fill a job vacancy. A person who, from among the blind, has a greater amount of the required ability stands a better chance of being successful and finding job satisfaction than one who has a lesser amount of the ability. The problem is not solved by avoiding the measurement of the particular ability. It may also happen that a job similar to the industrial position will occur in a blind agency workshop. Here too, the same test might be of value in promoting both individual job satisfaction and the efficient operation of the workshop.

With regard to Bauman's reason for and rejection of the Purdue Pegboard, it should be pointed out that Curtis (1950) has reported the adaptation of this instrument for use with the blind. The adaptation involved "very little special adjustment", and the test is evaluated as providing a significant addition to the results of other manipulative tests (Curtis, 1950, p. 329). Curtis also provides normative data for the Purdue Pegboard on a sample of 70 blind subjects. No reliability or validity data are presented; however, the author does mention that preliminary results indicate that a meaningful relationship exists between test performance and achievement in training or employment involving finger-hand dexterity.

In a further report, Bauman (1950) presents distributions of the scores of 79 employed blind and 361 "comparative" blind on the Minnesota Rate of Manipulation Test and the Pennsylvania Bi-Manual Worksample. The "comparative" group is so labeled because, according to the author, "in many cases it has not been possible for me to obtain any information about the person", and consequently the group could not be referred to as an "unemployed" sample (Bauman, 1950, p. 105). Some of the individuals comprising the comparative group were known to be unemployed; others had been employed but had not been successful in their employment; and some were students. An inspection of the compared distributions does indicate that both instruments meaningfully differentiate between the two groups.

Bauman and Hayes (1951) again suggest the use of the Minnesota Rate of Manipulation Test, the Pennsylvania Bi-Manual Worksample, and a

small parts dexterity test for use with the blind. No reports of the reliability or validity associated with the use of these tests are given, and the authors mention that no such data have been published. Bauman again presents the position that since the blind worker must compete with the sighted worker, comparison must be made between blind and sighted norms for a particular test. The latter is interpreted to suggest that Bauman regards norms established solely on blind people to be of slight practical utility.

A more recent study by Bauman (1954) reports the results of an extensive study on a sample of 443 legally blind persons from six states. The sample was stratified into three major groups: (A) employed and generally well adjusted, N = 162; (B) not successful in employment, but otherwise generally well adjusted, N = 150; (C) not successful in employment and generally poorly adjusted, N = 131. Included in the battery of tests administered to each person was the Pennsylvania Bi-Manual Work-sample. The reliability of this instrument is reported to be .95 as determined by the split-halves method and stepped-up using the Spearman-Brown formula. The degree of validity of the instrument is not reported as such; however, comparison between the scores obtained by people in the three major groups mentioned above demonstrates that the test meaningfully differentiated between groups A and C, and B and C. The distinction between groups A and B, in terms of performance on the test, was slight.

Raskin and Weller (1953) mention a project being conducted by the United States Civil Service Commission to develop tests for the blind,

"which would be of 'practical equivalence' to tests for the sighted" (Raskin & Weller, 1953, p. 20). The tests, designed to measure elements of job success, include measures of gross hand dexterity, fine finger dexterity, pattern matching, following oral instruction, mechanical information, and form perception.

The Civil Service Commission has published a report (Tests for Blind Competitors for Trades and Industrial Jobs in the Federal Civil Service, 1956) describing some early examinations of the instruments mentioned above by Raskin and Weller. The general nature of the tests is apparent from the descriptive titles above with the exceptions of the pattern matching test and the form perception test. These instruments are described as follows (Tests for Blind Competitors for Trades and Industrial Jobs in the Federal Civil Service, 1956, p. 6):

> ... the regular pattern-matching test is given to sighted persons in pictures, while the test for blind workers consists of plastic shapes which are to be felt by the examinee. The difficulty level of each question with the plastic pieces was gauged as well as possible to the difficulty of regular test questions. Special adaptations had to be made. For example, in the regular test, each question shows four patterns, and the examinee chooses the pattern that can be made from a particular set of pieces... The fact that the patterns differ from question to question causes no difficulty to sighted competitors. With blind workers, in order not to introduce a difficulty that is not present for the seeing, the same basic patterns are used for a number of questions. Similarly, in the form-perception test, sighted competitors choose the one of five pictures which is different from the others in a question. For blind competitors, the test is made up of plastic shapes. In each question, one shape differs from the others. The competitor is to find, by feeling the shapes, which is the different one.

The results of a few small sample reliability studies are given, "on jobs where the tests appeared to be appropriate" (Tests for Blind Competitors for Trades and Industrial Jobs in the Federal Civil Service, 1956, p. 7). No reliability estimates are given for the fine finger dexterity test, the pattern matching test, or the test of mechanical information. For the remaining instruments, retest reliabilities based on three administrations of an instrument to each person ranged as follows: gross dexterity test .93 - .97, N = 8; alinement dexterity test .88 - .99, N = 6; following oral directions .59 - .90, N = 5; form perception test .94 - .95, N = 7. The writers of the monograph were aware that the number of cases on which these reliability estimates are based is very small, and they suggest that "the results ... are probably within the general area of the true reliabilities" (Tests for Blind Competitors for Trades and Industrial Jobs in the Federal Civil Service, 1956, p. 7). No validity coefficients, as such, are given for these tests. Evidence is presented, however, which indicates that these instruments may prove a meaningful addition to the aptitude testing of blind people for trade and industrial jobs.

Macfarland (1956), in a study comparing the efficiency of blind and sighted workers, offers evidence that the Minnesota Rate of Manipulation Test and the Pennsylvania Bi-Manual Work Sample are applicable for use with the blind. Worchel (1951), in a report of three experiments comparing the spatial perception and orientation of blind and sighted students, describes some methods that could prove of value for testing the tactual perceptiveness and manual ability of the blind.

__Further Considerations in Testing the Blind__. Perhaps more important than the fact that the blind use their hands in so many occupations, is the nature of the use that they make of their hands in these occupations. The sighted worker, if he were performing similar jobs, would generally use a combination of coordinated eye-hand movements to construct, assemble or perform whatever the job tasks. The blind worker, of necessity, substitutes tactual perception for visual perception. Touch is used to identify, discriminate and locate, as well as to place, construct and assemble. This ability to identify, discriminate, place, and perceive relationships influences how well a blind person can effectively use, in the employment situation, whatever hand coordination or manipulative abilities he possesses.

It would thus seem of importance that a psychological test, to measure most meaningfully the manipulative ability of the blind, take into account by design how well a blind person can utilize or bring to bear this ability in the employment situation. That is, the test should measure how well the person can identify, discriminate, locate, perceive relationships, or all of the foregoing — the person's tactual perceptiveness — as well as how well the person can manipulate or make coordinated movements.

Another consideration involved in the special ability testing of the blind stems from the fact that between 65 to 70 per cent of the approximately 320,000 legally blind persons in the United States are partially sighted (Hurlin, 1953). Several of the studies already referred to have shown that the partially sighted do have an advantage

on some psychological tests in comparison with the totally blind. The problem arises as to whether it is necessary to control for this amount of remaining vision in the testing of legally blind persons. Of the several people who have in the past conducted research with the blind, a majority has apparently felt that it was necessary to control for degree of vision. Their method of control has, in general, been one of the following three: (1) the development of separate test norms for different visual groups; (2) the attempt to hold, artificially, vision constant — for example, through the use of a blindfold or screen; (3) the selection of a sample so as to exclude the partially sighted. If control for vision is desired, and this has yet to be proven necessary, only method (1) merits attention. Method (3) excludes a majority of the blind population, and method (2) is in many respects unrealistic.

The more logical solution to this problem, with regard to vocational selection and placement, is to develop psychological tests in a format that can be handled by even the totally blind — then, allow remaining vision to exert whatever its natural influence. Should remaining vision allow a partially sighted person to achieve a better score on a valid special ability test, then this _is_ a realistic appraisal of the ability that can be brought into the job situation. To treat such findings otherwise, in the light of present knowledge, amounts to penalizing the partially sighted worker for his greater ability.

Purpose. The purpose of this research was to develop a special ability test for use with the adult blind which would yield a combined measure of both tactual perceptiveness and manipulative dexterity. It

was hypothesized that the combination of tactual perceptiveness and manipulative dexterity in a single instrument would serve the following objectives: (1) a more meaningful measurement of the manipulative ability of the blind; (2) a higher validity coefficient with respect to criteria of vocational success, since the test would simultaneously measure two abilities required of the blind for jobs involving use of the hands. Specific objectives included the estimation of the reliability of the test, the estimation of the validity of the test, and the providing of information on the factorial structure of the test. Further considerations included that the test be easy to administer, allow for objective scoring, not require excessive testing time, and be relatively inexpensive to manufacture and make available, if results should warrant.

DEVELOPMENT OF THE TEST

Format and Nature. It was decided, after consideration and thought, to develop the test using a pegboard format. The pegboard format would allow for a measure of manipulative dexterity. It would also be applicable for the totally blind, be relatively easy to administer, and allow for objective scoring. Moreover, it would be possible to measure tactual perceptiveness simultaneously in this format. The latter would be accomplished by dividing the pegboard into two identical halves, constructing one or more patterns or configurations on one of the halves, and requiring subjects to reconstruct the given patterns on the other half of the board, using other pegs.

The several aspects of tactual perceptiveness involved in the task stem from the following. An examinee, to reconstruct a given pattern or configuration, would have to determine what had been constructed and where on the examiner's half of the pegboard it was located. He would then have to place other pegs in the correct relationship to one another on his half of the board, and his configuration would have to be in the same location as the given pattern. Since the decision would be left to the examinee as to when he had completed a given pattern, it would be necessary for him to check and compare his reproduction with the given configuration.

If the examinee were also instructed to work as rapidly as possible (but not to sacrifice accuracy), his manipulative ability in handling

and placing pegs would influence the time required for him to reconstruct a given pattern.

The above describes the nature of the test decided upon. It was felt that a single score, combining the accuracy of reconstruction and location per unit of time on this test, would be a measure of both perceptual ability and psychomotor ability.

Construction. The instrument was constructed of 1/8-inch aluminum sheet, measuring 12 1/2- by 11-inches, and mounted on 3/4-inch bakelite plate of the same dimensions. Pegs, 1-inch in length, were machined from 1/4-inch round aluminum stock. With the aluminum sheet mounted on the bakelite, holes were uniformly drilled across the face of the board, in pegboard fashion, using a letter "F" drill .257-inch in diameter. This resulted in a uniform clearance of .007-inch between any peg and any hole on the board. Each hole was drilled to a depth of 7/16-inch into the bakelite, thus leaving 7/16-inch of each peg above the surface of the board (taking into account the 1/8-inch thickness of the aluminum faceplate). Strips of 1/8-inch aluminum sheet, 5/16-inch wide, were mounted on both of the 11-inch edges of the aluminum faceplate to define the sides of the pegboard. Another strip of 1/8-inch aluminum sheet, 1/4-inch wide and 11-inches long, was mounted in the center of the board to define the division of the board into two identical halves. (See Figure 1.)

On either half of the board, there were seven holes in each row and 13 holes in each column. The distance between the centers of any two

Figure 1

Picture of the Tactual Reconstruction Pegboard

holes, measuring vertically or horizontally on either half of the board, was 3/4-inch. Between the inside edges of the aluminum strips defining the sides and halves of the board, the distance was 3/4-inch to the center of the holes in the outside columns. The distance between the undefined top and bottom of the board to the center of the outside rows was 1-inch. It should be mentioned that aluminum was selected as the faceplate material so that hole size would not vary with repeated testing — a situation which can occur with wooden boards (Ghiselli, 1949). Similarly, care was taken to insure that each hole on the board was of uniform depth, so that examinees would not be distracted or lose time by trying to force a peg into a shallow hole or remove a peg from an overly deep hole.

The size of the peg (diameter), its height above the board, and the distance between holes were all chosen to allow for a measure of gross finger dexterity, and also to insure that any relationship between pegs would not be perceived incorrectly as a result of the pegs being either too short or too close together. With regard to gross finger dexterity, this seems to be more commonly involved in jobs filled by blind workers than is precision or fine finger dexterity.

Six patterns or configurations of pegs were chosen as the test items. The total of six items was decided upon to insure an adequate sample of a person's ability. It was also hoped that six items, all apparently measuring the same combination of abilities, would result in the test scores having a satisfactory reliability of measurement. The six items and two practice items, which were used in familiarizing examinees with the test, are shown in Figure 2. Items 1, 2 and 3 consisted of a total of eight pegs each, and items 4, 5 and 6 consisted of a total of 12 pegs each.

These six items were selected, from the many configurations possible, with the following considerations in mind. Although the task involved in the test was not considered especially difficult, it was anticipated that those items in which the pegs comprising the configuration were more spread out, in comparison with others, might be more difficult. Itwas also suspected that the greater the number of pegs in a given item, depending upon their arrangement, the more difficult the item would be. With regard to the latter, it seemed that items composed of a large number of pegs might require a greater degree of concentration and/or awareness. That is, there would be more opportunity for an examinee to overlook a part of the given configuration, and the examinee might lose his orientation or reference

Figure 2

Test Items for the Tactual Reconstruction Pegboard

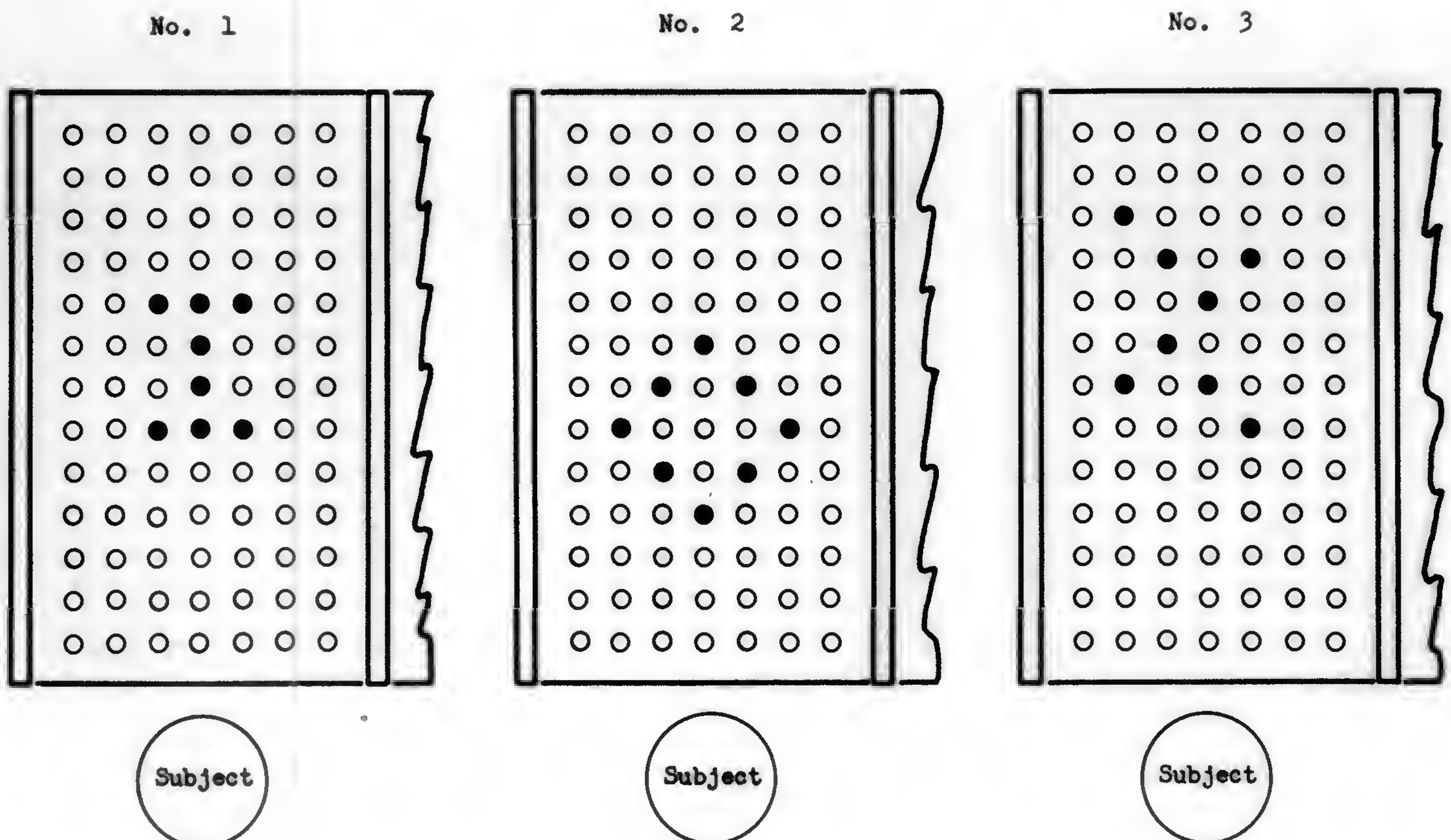


Figure 2 (Continued)

Test Items for the Tactual Reconstruction Pegboard

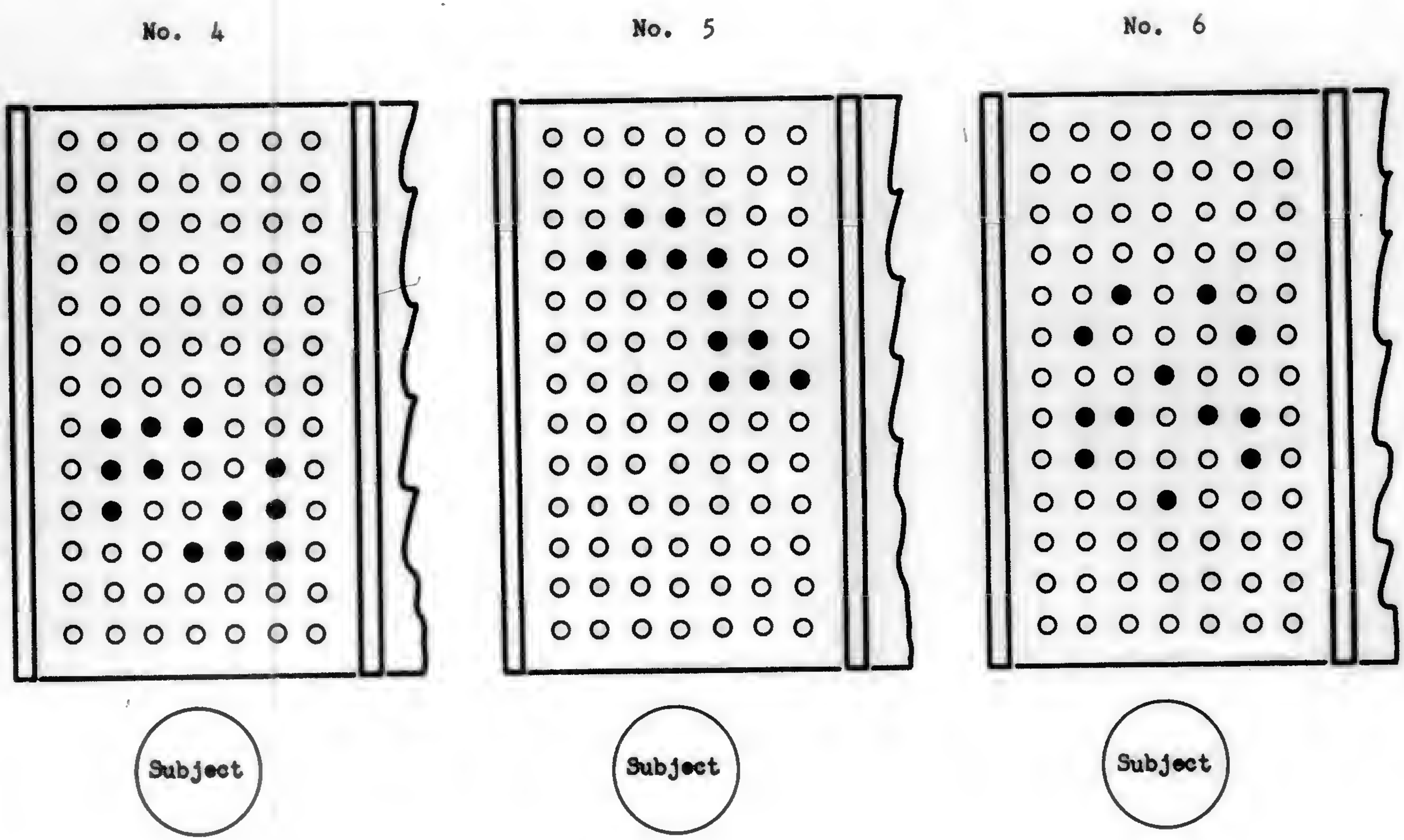
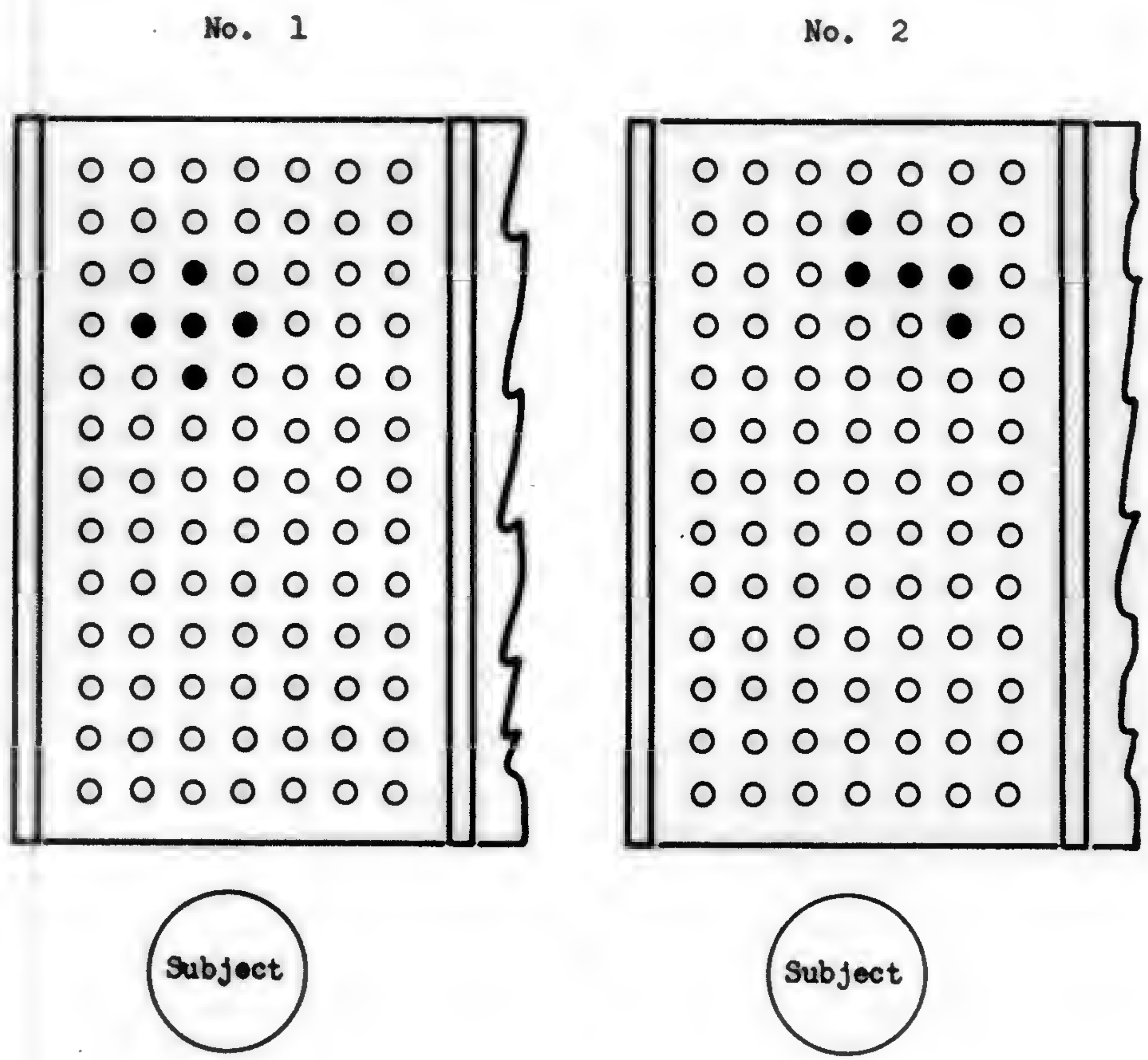


Figure 2 (Continued)

Practice Items for the Tactual Reconstruction Pegboard



point in either or both the given configuration or his reconstruction of it.

The order in which the items were to be presented to examinees was also based on the above considerations. It can be seen in Figure 2 that the first three items, involving eight pegs each, progress from a configuration that is relatively close knit to one that is more spread out. Similarly, items 4, 5 and 6, involving twelve pegs each, progress from a close knit configuration to one that is more spread out. With this arrangement, it was hoped that the test items would be presented to examinees in at least a partial order of increasing difficulty.

<u>The Sample</u>. The sample on which the test was developed consisted of 318 legally blind persons from three midwestern states. In selecting the sample, the following restrictions were used. A person, in order to be tested, had to be: (1) legally blind; (2) between the ages of 20 - 50 years; (3) affected by no other major handicap.

"Legally blind" refers to the generally accepted definition of blindness, i.e., any visual condition between 20/200 and total blindness and/or the restriction of the angular visual field to 20 degrees or less. These conditions apply to the better eye with maximum correction. The age limitation was used because the test was being developed to assist in problems of vocational selection, placement and counseling with the adult blind. The ages of 20 - 50 generally represent the peak employment period for most people, regardless of handicap. Persons with limitations other than blindness were excluded because it was felt that these other conditions might affect both their ability as measured by the test

and their present employment status. Present employment status was of importance because any estimates of the validity of the test would of necessity be of a "concurrent" nature (Technical Recommendations for Psychological Tests and Diagnostic Techniques, 1954).

The sample, stratified according to testing site, was as follows:

(1)	Indianapolis, Indiana	N = 59
(2)	Lafayette, Indiana	N = 5
(3)	Fort Wayne, Indiana	N = 36
(4)	Evansville, Indiana	N = 21
(5)	Muncie, Indiana	N = 12
(6)	Marion, Indiana	N = 7
(7)	St. Louis, Missouri	N = 68
(8)	Chicago, Illinois	N =110

The sample was also stratified into several categories of employment. These categories, in general, represented where or in what situations the blind persons comprising the sample were employed. Initially, it had been decided to stratify the sample into three such categories: (1) outside employed blind -- those people self-employed or employed in outside industry and competing with sighted co-workers; (2) shop employed blind -- those people employed in traditional blind industries such as the state, blind agency, or private workshops employing the blind; (3) unemployed blind -- those people with a history of unemployment who were either unemployed or had been laid off from work for a period of six months or more at the time of testing. In attempting to stratify the sample into the above three categories, it became apparent that some

people were either unique to these categories or did not fit the categories as defined. To overcome such difficulties and increase the preciseness of the resulting stratification, the number of categories was increased to seven. The categories and the number of persons in the sample who were assigned to each were as follows:

(1)	Outside Employed	N = 84
(2)	Shop Employed	N = 105
(3)	Unemployed	N = 34
(4)	Part-time Employed	N = 27
(5)	Agency Personnel	N = 28
(6)	Vending Stand Personnel	N = 12
(7)	Not Otherwise Accounted For	N = 28

Categories (1), (2) and (3) remain as defined above. The "part-time employed" category includes people in both competitive industry and blind agency shops not employed on a full-time basis. An example of a person placed in this category was a self-employed piano tuner who earned, on the average, approximately eight dollars a week from his work. "Agency personnel" includes those blind persons who are the administrators, home teachers, counselors and trainers working at blind or private agencies. The "vending stand personnel" category covers those blind persons who operate vending stands and those salesmen, working for blind agencies, who do door-to-door selling of blind-made products. Since the latter neither worked in the shops nor performed job functions similar to those workers employed in shops, it was felt that they should not be grouped with the "shop employed". The "not otherwise

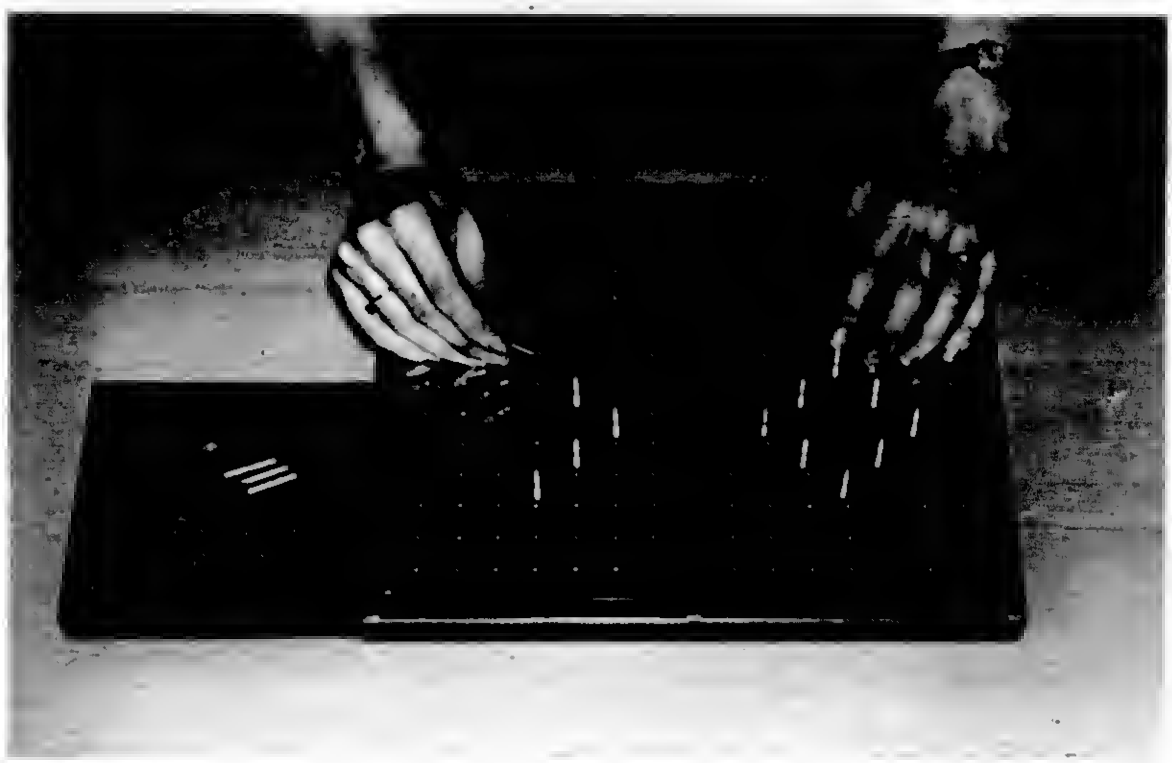
accounted for" category includes housewives, students, and other persons who did not fit categories (1) through (6).

It should be mentioned that one of the purposes for stratifying the sample into general employment situation was to determine later how well the test differentiated among the outside employed, the shop employed, and the unemployed. One of the often expressed objectives of vocational rehabilitation efforts with the blind is to place as many able persons as possible on jobs in outside competitive industry. If the test did differentiate among these three groups, it was felt that the test could then be of assistance in identifying such "able" blind persons. The extent to which the test did differentiate among these groups would be an estimate of the concurrent validity of the test for use with the adult blind.

Administration. The test was administered individually to each subject, and standard verbal instructions were used. (A sample of the instructions for administration is given in Appendix A.) The examiner first determined a subject's hand preference and then proceeded to explain the nature of the task. Examinees were allowed to familiarize themselves with the test board and the location of a wooden dish containing the aluminum pegs. This dish of pegs was always placed beside and at the top of the test board on the side corresponding to an examinee's hand preference. The latter was done so that an examinee would be picking up, locating as necessary, and placing pegs in the board with his preferred hand. (See Figure 3.) Each subject then reconstructed

Figure 3

Subject Being Given the Tactual Reconstruction Pegboard



two practice patterns, and during this time the examiner answered any questions and corrected any misunderstanding. The practice patterns and subsequent test configurations were always built in the same holes on the examiner's half of the board. (The location for each pattern is shown in Figure 2.) The examiner's half of the board, on which the practice and actual test items were presented to a subject, was always that half of the pegboard (as divided by the center aluminum strip) opposite the side of an examinee's hand preference.

In the course of the instructions, the examiner told each subject that his performance on each test item would be timed; however, it was emphasized that the examinee should strive for accuracy of reconstruction

and location of the given pattern, i.e., "you (to the subject) concentrate on accuracy ... as soon as you are finished and satisfied with what you have built, tell me that you are through". The examiner did not tell subjects that there were maximum time limits (to be explained) on each item. If the examiner was questioned about time limits, he responded that there were upper time limits which would be used only if the subject experienced excessive difficulty. Most subjects easily completed every item, to their own satisfaction, well within the time allowed. In those few instances when the allowed time was exceeded and it appeared that the examinee was only becoming further confused, the examiner suggested that effort be discontinued and the next item be attempted. The examiner in no case stopped any subject in an abrupt manner.

With regard to the above mentioned time limits, it became apparent, in the course of administering the test, that some few examinees would continue to work on an item for a considerable amount of time if allowed to do so. It was also evident that this continued effort generally resulted in little if any improvement in the reconstructed configuration. Further, as will be apparent in the section concerning the scoring of the test, this additional time generally would not improve, and could lower, a person's final score on an item. To avoid both excessive testing time and subject fatigue, it was decided to establish an upper time limit for each item. These time limits were determined using data which were available on approximately the first 100 subjects. For each item, a frequency distribution was made of the time required by those individuals who had reconstructed the item correctly. The time limits were

then established by choosing a time within which 95 per cent of these examinees had completed an item. As mentioned earlier, it was rare that these time limits were invoked. The time limits for each item were as follows:

Item	Time	Item	Time
1	5 minutes	4	7 minutes
2	6 minutes	5	6 minutes
3	10 minutes	6	10 minutes

While there was no way of estimating the motivation level of the subjects, it is believed that their motivation was generally high. The subjects were financially compensated for their time, and they knew that their performance was being evaluated with reference to how quickly they could achieve a given level of accuracy. For the most part, the conditions under which the test was administered were a private and quiet room.

It should be mentioned that a pure measure of manipulative dexterity was also obtained on 266 of the subjects using the same pegboard. Essentially, this measure consisted of how many pegs a person could place in the board during a one and one-half minute time period. (Detailed instructions for use of the pegboard in this manner are presented in Appendix C.) These data were collected in order to determine later the intercorrelation between this measure of rate of placement with the reconstruction task and to assist in defining the factorial nature of the reconstruction task.

Scoring. For each item on the test, a record was made of the pattern as reconstructed by the subject and the time required for this reconstruction. (See sample data recording sheet, Appendix A.) A person's performance on each item was then scored on the basis of (1) accuracy of reconstruction, (2) correctness of location, and (3) time required. "Accuracy of reconstruction" referred to the shape of the configuration or the relationship between pegs. "Location" referred to where, on the examinee's half of the pegboard, the entire pattern was located. It was possible for a subject to reconstruct accurately a given pattern but not locate the configuration in the same position on the board as the given configuration. "Time" denoted the minutes and seconds that elapsed starting with the presentation of a pattern to the subject and ending when the subject informed the examiner that he was through.

The numerical value of these scores was developed on the basis of logical considerations. For accuracy of reconstruction, a subject received as many points as he placed pegs in the correct relationship to one another. Hence, if an item consisted of a total of eight pegs, and a subject placed seven pegs in the board and in the correct relationship to one another (with reference to the given pattern), the subject received seven points for accuracy. If the item was reconstructed perfectly, a subject received one additional point for this perfect accuracy. It was considered logical to give this additional point for a perfect reconstruction, since a subject usually spent extra time in checking his work to achieve this accuracy. The correctness of location, which was a relatively minor aspect of the total task, was scored by merely subtracting

one point from a subject's accuracy points if the configuration were incorrectly located, regardless of the magnitude of the incorrect location. The sum of a person's accuracy points, plus one point for perfect accuracy, minus one point for an incorrect location, constituted a person's raw score on each item. (Detailed instructions for scoring with examples are presented in Appendix B.)

A person's raw score and the time associated with this raw score were then combined into a single numerical index for each item by dividing the raw score points by the common logarithm (base 10) of the time in seconds. This numerical value (with the decimal point moved one position to the right after division and rounding to the nearest whole number) constituted a subject's "index score" on an item. (See Table 1.) The sum of the index scores on the six items was used as a person's performance score on the test.

The common logarithm of time was used as the denominator in computing the index score because it was desired that the scoring system differentiate maximally both between the higher raw scores and between the shorter time periods. The latter was deemed necessary since frequency polygons of the raw scores for each item showed that the distributions of scores on all six items were highly skewed toward the high end. That is, the modal score for each item was that score representing perfect or near-perfect reconstruction. Moreover, it was observed that there was a relationship between raw score points and time required. Those subjects who were more accurate in reconstruction tended to be those who required a shorter period of time to reconstruct each item. As can be seen in

Table 1

Table for Converting Raw Scores to Index Scores

Time Min.	Time Sec.	Raw Score 13	12	11	10	9	8	7	6	5	4	3	2	1
	15	110	102	94	85	77	68	60	51	43	34	26	17	9
	30	88	81	74	68	61	54	47	41	34	27	20	14	7
	45	79	73	67	60	54	48	42	36	30	24	18	12	6
1:	00	73	67	62	56	51	45	39	34	28	22	17	11	6
	15	70	64	59	53	48	43	37	32	27	21	16	11	5
	30	67	61	56	51	46	41	36	31	26	20	15	10	5
	45	64	59	54	49	45	40	35	30	25	20	15	10	5
2:	00	63	58	53	48	43	39	34	29	24	19	14	10	5
	15	61	56	52	47	42	38	33	28	23	19	14	9	5
	30	60	55	51	46	41	37	32	28	23	18	14	9	5
	45	59	54	50	45	40	36	32	27	23	18	14	9	5
3:	00	58	53	49	44	40	35	31	27	22	18	13	9	4
	15	57	52	48	44	39	35	31	26	22	17	13	9	4
	30	56	51	47	43	39	34	30	26	22	17	13	9	4
	45	55	51	47	43	38	34	30	26	21	17	13	9	4
4:	00	54	50	46	42	38	34	29	25	21	17	13	8	4
	15	54	50	46	42	37	33	29	25	21	17	12	8	4
	30	53	49	45	41	37	33	29	25	21	16	12	8	4
	45	53	49	45	41	37	33	29	24	20	16	12	8	4
5:	00	52	48	44	40	36	32	28	24	20	16	12	8	4
	15	52	48	44	40	36	32	28	24	20	16	12	8	4
	30	52	48	44	40	36	32	28	24	20	16	12	8	4
	45	51	47	43	39	35	32	28	24	20	16	12	8	4
6:	00	51	47	43	39	35	31	27	23	20	16	12	8	4
	15	51	47	43	39	35	31	27	23	19	16	12	8	4
	30	50	46	42	39	35	31	27	23	19	15	12	8	4
	45	50	46	42	38	35	31	27	23	19	15	12	8	4
7:	00	50	46	42	38	34	30	27	23	19	15	11	8	4
	15	49	45	42	38	34	30	27	23	19	15	11	8	4
	30	49	45	41	38	34	30	26	23	19	15	11	8	4
	45	49	45	41	37	34	30	26	22	19	15	11	8	4
8:	00	48	45	41	37	34	30	26	22	19	15	11	7	4
	15	48	45	41	37	33	30	26	22	19	15	11	7	4
	30	48	44	41	37	33	30	26	22	18	15	11	7	4
	45	48	44	40	37	33	29	26	22	18	15	11	7	4
9:	00	48	44	40	37	33	29	26	22	18	15	11	7	4
	15	47	44	40	36	33	29	26	22	18	15	11	7	4
	30	47	44	40	36	33	29	25	22	18	15	11	7	4
	45	47	43	40	36	33	29	25	22	18	14	11	7	4
10:	00	47	43	40	36	32	29	25	22	18	14	11	7	4

Table 1, the use of time expressed in common logarithmic form resulted in the following: (1) for any raw score total on an item, the index scores progressed in a geometric manner from the longest to the shortest time period with maximum differentiation between the shorter time periods; (2) as raw score increased, the range of index points increased within a raw score level and the associated time intervals.

With regard to the intervals represented by the time column in Table 1, it was decided for the purpose of convenience to use 15-second intervals. Each tabled value represented those times from 1/2-second greater than the preceding, shorter time value to 1/2-second greater than the particular value. For example, "30-seconds" covered those elapsed time periods from 15.5-seconds to 30.5-seconds. Similarly, "1:00-minute" represented those times from 45.5-seconds to 60.5-seconds (or one minute and .5-second).

It was felt that this scoring system, with reference to the nature of the task, did yield a logical combination of the perceptual and psychomotor aspects of the test. Further, it was hoped that this scoring system would result in a distribution of the total scores on the test (over the entire sample) which would approximate the shape of the normal probability curve. The latter was desirable because of the assumptions underlying the several statistical treatments to which the test data would be subjected in determining the usefulness of the instrument.

RESULTS

<u>Distribution of Scores and Item Difficulties</u>. The perf
each subject on all six items of the reconstruction task was
converted into a total index score as discussed above. Thes
then distributed in a frequency polygon over the entire samp
subjects. The resulting frequency polygon, with a class int
points for the total index scores, is shown in Figure 4. It
in Figure 4, that the scoring system did result in a distrib
total scores that had a shape approximating that of the norm
lity curve. The arithmetic mean over the entire sample was
a standard deviation of 84.87.

With regard to item difficulties, the relative difficult
items was estimated by computing the mean and standard deviat
each item. In general, a lower mean score and a larger stand
tion were considered as indicative of a more difficult item.
and standard deviation for each item, computed over the entir
are as presented in Table 2.

Table 2

Means and Standard Deviations for the Test Items

Item	Mean	S.D.	Item	Mean
1	42.74	12.10	4	54.65
2	35.48	15.58	5	56.21
3	32.64	14.31	6	46.71

RESULTS

<u>Distribution of Scores and Item Difficulties</u>. The performance of each subject on all six items of the reconstruction task was scored and converted into a total index score as discussed above. These scores were then distributed in a frequency polygon over the entire sample of 318 subjects. The resulting frequency polygon, with a class interval of 15 points for the total index scores, is shown in Figure 4. It can be seen, in Figure 4, that the scoring system did result in a distribution of total scores that had a shape approximating that of the normal probability curve. The arithmetic mean over the entire sample was 268.44 with a standard deviation of 84.87.

With regard to item difficulties, the relative difficulty of the items was estimated by computing the mean and standard deviation for each item. In general, a lower mean score and a larger standard deviation were considered as indicative of a more difficult item. The mean and standard deviation for each item, computed over the entire sample, are as presented in Table 2.

Table 2

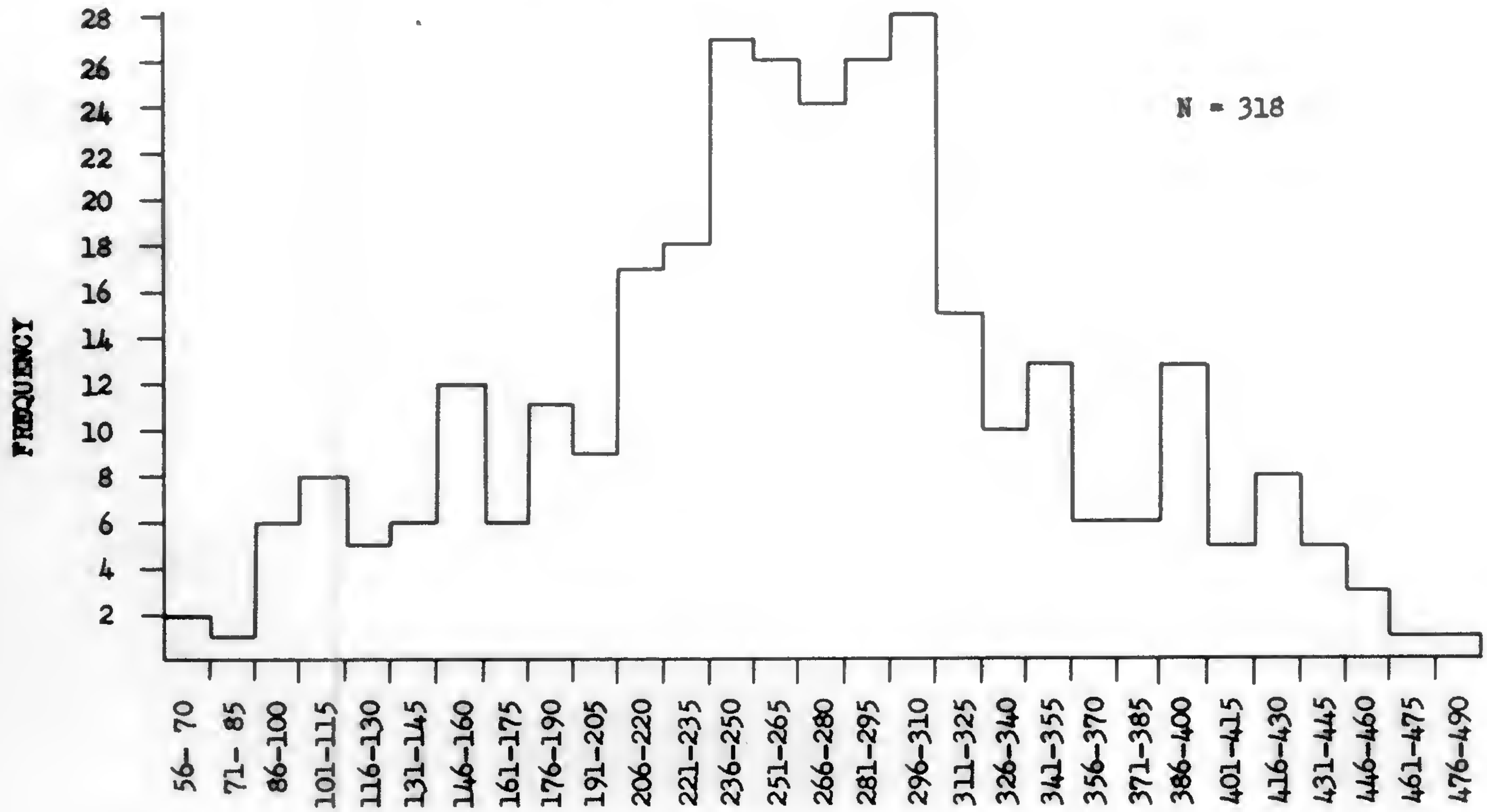
Means and Standard Deviations for the Test Items

Item	Mean	S.D.	Item	Mean	S.D.
1	42.74	12.10	4	54.65	17.49
2	35.48	15.58	5	56.21	17.32
3	32.64	14.31	6	46.71	19.89

Figure 4

Frequency Polygon of the Total Index Scores

on the Tactual Reconstruction Pegboard



In considering the above means and standard deviations as an estimate of the relative difficulty of each item, items 1, 2 and 3, which consisted of a total of eight pegs each, should be regarded separately from items 4, 5 and 6, which consisted of a total of twelve pegs each. Because of the greater number of pegs in the latter three items, the means and standard deviations of these items are not strictly comparable with those of items 1, 2 and 3. It can be seen, in Table 2, that items 1, 2 and 3 were presented to subjects in an increasing order of difficulty. For items 4, 5 and 6, item 5 was apparently somewhat easier than item 4. A $\underline{t}$ test was computed on the difference between the means of items 4 and 5 (Walker & Lev, 1953). This resulted in an observed value of $t = 1.13$ with 634 degrees of freedom. As this observed $\underline{t}$ value was not significant at the .10 level, it was concluded that the difference between the means of items 4 and 5 was slight and not of practical consequence. In view of the foregoing, it was felt that the items had been presented to subjects in a general order of increasing difficulty.

Reliability. The internal consistency reliability of the scores on the test, over the entire sample of 318 subjects, was computed using Hoyt's analysis of variance method (Thorndike, 1949). In the analysis of variance method, which yields a reliability estimate equivalent to the average of all possible split halves,

$$\text{reliability} = 1 - \frac{\text{Mean Square}_{\text{error}}}{\text{Mean Square}_{\text{between subjects}}}.$$

The obtained estimate of the internal consistency reliability was $r = .93$. The analysis of variance summary table is presented in Table 3.

Table 3

Summary Table for the Analysis of Variance

Estimate of Reliability

Source of Variation	SS	df	MS
Between Subjects	381799.71	317	1204.42
Between Items	149358.06	5	29871.61
Error	125595.77	1585	79.24

$$\text{reliability} = 1 - 79.24/1204.42 = .934$$

Validity -- Criterion Groups. One estimate of the concurrent validity of the test was obtained by determining how well the test scores differentiated among the outside employed blind, the shop employed blind, and the unemployed blind. These groups, which were discussed in the section dealing with the sample, were referred to as criterion groups. As mentioned earlier, it was felt that the extent to which the test did differentiate among these three groups would evidence the potential utility of the instrument for use with the adult blind.

The estimates of the concurrent validity of the test, associated with these criterion groups, were determined by the use of expectancy charts and biserial coefficients of correlation. It should be noted that these estimates were determined using groups that had been established on the basis of general employment situation, regardless of the nature of the work performed by those people comprising the group. The

biserial correlation coefficient is appropriately computed when one variable is continuously distributed and the second variable is artificially dichotomized. It is assumed that a continuous distribution underlies the artificially dichotomized variable. The formula used in computing the biserial correlation coefficients was (Guilford, 1956, p. 299):

$$r_b = \frac{M_p - M_t}{\sigma_t} \times \frac{p}{y}$$

Where: M_p = the mean of the test scores for the higher group in the dichotomous variable

M_t = the mean of the total sample on the test

σ_t = the standard deviation of the total sample in the continuous variable

P = the proportion of cases in the higher group

y = the ordinate of the normal curve at the point of division between the proportions of cases falling in the higher and lower groups.

The obtained biserial correlation coefficient between the outside employed blind (N = 84) combined with the unemployed blind (N = 34) with total index scores on the test was r = .58. An expectancy chart, portraying this relationship, is presented in Figure 5. Also presented in Figure 5 are the theoretical expected proportions of outside employed blind for various selection ratios. The latter, determined from the Taylor-Russell Tables (Tiffin & McCormick, 1958), are based on a validity coefficient of r = .55 and the approximate proportion of outside employed blind to the total of outside employed blind plus the unemployed blind in the present sample, i.e., 70 per cent.

Figure 5

Expectancy Chart Between Outside Employed Blind

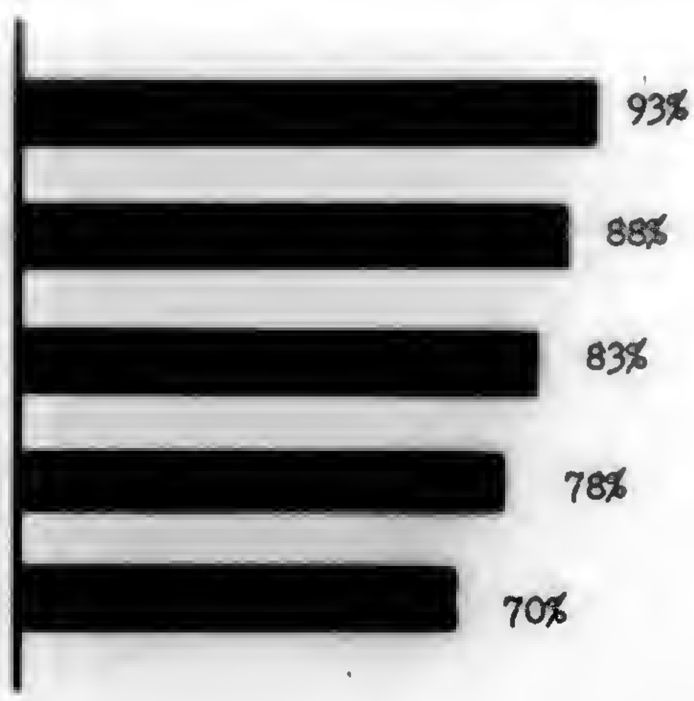
Combined with Unemployed Blind with Test Scores

Split	Score Range	N	% of Outside Employed Blind
Halves	271 - 450	60	88%
	71 - 270	58	52%

Theoretical Expected Proportions of Outside Employed Blind

for Various Selection Ratios

Selection Ratio	Score Range	% of Outside Employed Blind
Top 20%	331 - 450	93%
Top 40%	291 - 450	88%
Top 60%	251 - 450	83%
Top 80%	211 - 450	78%
100%	71 - 450	70%



The biserial correlation coefficient obtained between the outside employed blind (N = 84) combined with the shop employed blind (N = 105) with total index scores on the test was r = .47. An expectancy chart, portraying this relationship, is presented in Figure 6. Also presented in Figure 6 are the theoretical expected proportions of outside employed blind for various selection ratios. The latter, determined from the Taylor-Russell Tables (Tiffin & McCormick, 1958), are based on a validity coefficient of r = .45 and the approximate proportion of outside employed blind to the total of outside employed blind plus the shop employed blind in the present sample, i.e., 50 per cent.

The biserial correlation coefficient obtained between the shop employed blind (N = 105) combined with the unemployed blind (N = 34) with total index scores was r = .07. As the test scores did not differentiate between these two groups, no expectancy chart is presented.

It can be seen, from both the expectancy charts and the obtained biserial correlation coefficients, that scores on the test did meaningfully and to a reasonably high degree differentiate between the outside employed and the unemployed, and between the outside employed and the shop employed. The fact that the test did not differentiate between the shop employed and the unemployed resulted from the fact that both the shop employed blind and the unemployed blind, as groups, scored in the same, low performance range on the test. In the course of testing the shop employed people, it was often apparent that, as a group, they were generally low with respect to other abilities in addition to those measured by this instrument.

Figure 6

Expectancy Chart Between Outside Employed Blind
Combined with Shop Employed Blind with Test Scores

Split	Score Range	N	% of Outside Employed Blind
Halves	261 - 480	98	60%
	61 - 260	91	27%

Theoretical Expected Proportions of Outside Employed Blind
for Various Selection Ratios

Selection Ratio	Score Range	% of Outside Employed Blind
Top 20%	321 - 480	75%
Top 40%	281 - 480	68%
Top 60%	241 - 480	62%
Top 80%	191 - 480	56%
100%	61 - 480	50%

For information purposes, the obtained mean score and standard deviation for each of the general employment groups into which the sample was stratified are presented in Table 4. These groups are explained in the section concerning the sample.

Table 4

Means and Standard Deviations for Each of the Employment Groups on the Tactual Reconstruction Pegboard

	Group	N	Mean	S.D.
(1)	Outside Employed	84	297.11	67.39
(2)	Shop Employed	105	232.88	84.60
(3)	Unemployed	34	222.91	72.57
(4)	Part-time Employed	27	250.22	76.77
(5)	Agency Personnel	28	356.25	59.46
(6)	Vending Stand Personnel	12	298.58	54.87
(7)	Not Otherwise Accounted For	28	287.89	82.44

Validity — Chicago Sample. Another estimate of the concurrent validity of the scores on the test was obtained on a sample of 32 shop employed blind persons in the Chicago area. This validity estimate was a measure of how well the test scores differentiated within one of the criterion groups. The people comprising the sample were all engaged in some

type of work that involved use of the hands. As criterion data, paired comparison ratings were obtained from four supervisors who knew the 32 employees. The supervisors, who each filled out a complete paired comparison booklet on the employees, designated which one of each pair of employees they regarded as the "better", taking all aspects of an employee's job performance into consideration.

The frequencies resulting from the above paired comparisons were converted to values on a normal distribution with a mean of 50 and a standard deviation of 10 using the tables provided with the Personnel Comparison System (Lawshe & Kephart, 1950). Hoyt's analysis of variance was then computed on the four sets of normalized values to determine the reliability of the ratings over the four supervisors. The obtained estimate of the reliability of the ratings was r = .86. The analysis of variance summary table is presented in Table 5.

Table 5

Analysis of Variance Summary Table for the Reliability of Ratings on the Chicago Sample

Source of Variation	SS	df	MS
Between Subjects	9399.38	31	303.21
Between Raters	.19	3	.06
Error	3902.31	93	41.96

$$r = 1 - 41.96/303.21 = .862$$

. As criterion data, paired
supervisors who knew the 32
d out a complete paired com-
d which one of each pair of
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ve paired comparisons were
n with a mean of 50 and a
rovided with the Personnel
Hoyt's analysis of variance
lized values to determine the
pervisors. The obtained esti-
r = .86. The analysis of
e 5.

he Reliability of Ratings
le

	df	MS
8	31	303.21
9	3	.06
1	93	41.96

= .862

As the ratings did have adequate reliability, the normalized values for each employee were totaled over the four raters to determine a single rating for each employee. The total ratings then became the criterion against which scores on the test were correlated to yield an estimate of concurrent validity. The Pearson product moment correlation between the total ratings and scores on the test was $r = .54$. This relationship is portrayed in expectancy chart form in Figure 7. In assigning the employees to the "superior" or "other" groups for the expectancy chart, the total ratings were again used as the criterion for this division. Also presented in Figure 7 are the theoretical expected proportions of high rated employees for various selection ratios. The latter, determined from the Taylor-Russell Tables (Tiffin & McCormick, 1958), are based on a validity coefficient of $r = .55$ and the proportion of high rated employees to the total number of employees in the Chicago sample, i.e., 50 per cent.

The obtained concurrent validity coefficient of $r = .54$, between scores on the test with total ratings, was significantly different from zero beyond the .01 level. This result and the expectancy charts shown in Figure 7 were considered to indicate that the test did meaningfully and to a useful extent differentiate within a criterion group, i.e., shop employed blind in this case.

For information purposes, the correlations between standard scores on the verbal section of the Wechsler Adult Intelligence Scale with the total ratings, and between the number of pegs inserted in the rate of placement use of the pegboard with the total ratings, are presented in Table 6. The intercorrelations between the tactual reconstruction

Figure 7

Expectancy Chart Between Chicago Ratings

with Scores on the Test

Split	Score Range	N	% of Employees Rated in High Group
Halves	241 - 320	16	75%
	101 - 240	16	25%

Theoretical Expected Proportions of High Rated Employees

for Various Selection Ratios

Selection Ratio	Score Range	% of High Rated Employees
Top 20%	271 - 320	81%
Top 40%	251 - 320	72%
Top 60%	231 - 320	65%
Top 80%	171 - 320	58%
100%	101 - 320	50%

pegboard, the WAIS, and the rate of placement are also presented in Table 6. A table is presented in Appendix D (Table 13) which lists each of the 32 subjects in the Chicago sample by code number with his respective total rating over the four judges and his scores on the tactual reconstruction pegboard, the WAIS and the rate of placement.

Table 6

Correlations Between WAIS with Ratings and Between Rate of Placement with Ratings

WAIS	r = .36
Rate of Placement	r = .19

Intercorrelations Between Tactual Reconstruction Pegboard, WAIS, and Rate of Placement

	WAIS	Rate
Reconstruction Pegboard ...	.36	.67
WAIS		.14

Validity -- St. Louis Sample. The concurrent validity of the scores on the test was also estimated on another sample of 52 shop employed blind persons in the St. Louis, Missouri area. This sample was also composed of people who were all engaged in some type of work that involved

use of the hands. As criterion data, triad comparison and paired comparison ratings were obtained from four supervisors. One supervisor rated 51 employees using the triad comparison method. The other three supervisors rated 21, 23, and 15 employees respectively, using the method of paired comparison. Those supervisors who used the paired comparison method designated which one of each pair of employees they regarded as "better", taking all aspects of an employee's job performance into consideration. The supervisor who used the triad comparison method indicated which one of each set of three employees he regarded as "best" and which one of the three he regarded as "poorest", taking all aspects of an employee's job performance into consideration.

The triad comparison method (Ball, 1917) was used for the one supervisor who rated 51 employees, in order to reduce the number of sets on which this person would have to make judgments. If the paired comparison method had been used, this supervisor would have had to make judgments on $\frac{N(N-1)}{2}$ or 1275 pairs of employees. Using the triad comparison method, the supervisor made judgments on 425 sets of three employees. With regard to the latter, the 51 employees were arranged in 425 sets of three employees each, with each employee occurring in 25 sets, and each pair of employees occurring together in a set once. Ball (1917, pp. 193-199) describes a procedure for constructing such triad comparison sets. It should be mentioned that by assigning a frequency of 2 to each employee judged as "best" and a frequency of 1 to each employee <u>not</u> marked (as either "best" or "poorest") in a triad set, the resulting total of frequencies over the entire comparison was exactly equivalent to the total of frequencies for a complete paired comparison for the same number of people.

The reliability of the above ratings, over the four raters, was determined in the following manner. Since one supervisor had rated almost the entire sample and the other three supervisors had rated essentially non-overlapping sub-groups of this sample, the frequencies resulting from each supervisor's ratings were used to rank-order the employees. These rank-order values were then converted to normalized standard score values with a mean of 50 and a standard deviation of 10, using Table XX in Walker and Lev (1953, p. 480). Pearson product moment correlations were then computed, using the normalized rank values, between each supervisor who had rated a small sample with separate normalized rank values for the same sub-samples as rated by the supervisor who had evaluated 51 employees. The obtained correlation coefficients were .81, .87, and .80 respectively for N = 21, N = 23, and N = 15. These obtained correlations were then transformed to Fisher's Z-values (Walker & Lev, 1953), averaged, and converted back to a correlation coefficient. The resulting coefficient, which was an estimate of the average reliability of the ratings, was r = .77. Since all but one employee had been rated by at least two supervisors, and some had been rated by three supervisors, the obtained reliability coefficient of r = .77 was stepped-up using the Spearman-Brown formula (Guilford, 1956) for two raters. The obtained final estimate of the reliability of the ratings was r = .87.

As the ratings did have adequate reliability, the frequencies from the triad comparison and the paired comparisons were converted to values on a normal distribution with a mean of 50 and a standard deviation of 10, using the tables provided with the Personnel Comparison System (Lawshe & Kephart, 1950). The resulting normalized values were then

used to determine an average rating value for each employee. The latter was accomplished as follows. Three Cartesian graphic plots were made, each of which used the normalized values of the supervisor who rated 51 employees as the abscissa or x-axis. The normalized values for one of the remaining three supervisors was used as the ordinate or y-axis respectively on one of the three plots. The equation for the linear regression of y on x was then determined algebraically for each of the plots, i.e., the regression of the normalized values from a supervisor who rated a sub-group on the values from the supervisor who rated the 51 employees. These three regression equations were $x' = .8122\ y + 10.07$, $x' = .7556\ y + 17.59$, and $x' = .7345\ y + 13.71$ respectively for the sub-samples of $N = 23$, $N = 21$, and $N = 15$. The regression equations were solved to determine three points, and the regression lines were then drawn on their respective plots. The rating value assigned an employee by a supervisor who judged a sub-sample was then read from the plot in terms of its value on the abscissa or the scale representing the rating values of the supervisor who evaluated 51 employees. This latter value was combined with the actual value for an employee from the supervisor who rated 51 employees, to determine an average normalized rating value for each employee.

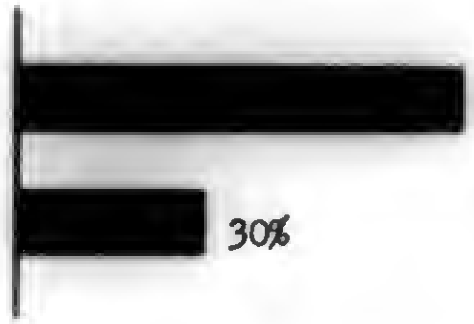
The concurrent validity of the test scores for this sample was then determined by correlating the average rating values with the scores on the test. The obtained Pearson product moment correlation was $r = .46$. An expectancy chart, portraying this relationship, is presented in Figure 8. In assigning the employees to the "superior" or "other" groups for the expectancy chart, the average ratings were again used as the

Figure 8

Expectancy Chart Between St. Louis Ratings

with Scores on the Test

Split	Score Range	N	% of Employees Rated in High Group
Halves	211 - 420	25	72%
	61 - 210	27	30%



Theoretical Expected Proportions of High Rated Employees

for Various Selection Ratios

Selection Ratio	Score Range	% of High Rated Employees
Top 20%	311 - 420	75%
Top 40%	241 - 420	68%
Top 60%	191 - 420	62%
Top 80%	141 - 420	56%
100%	61 - 420	50%

criterion for this division. Also presented in Figure 8 are the theoretical expected proportions of high rated employees for various selection ratios. The latter, determined from the Taylor-Russell Tables (Tiffin & McCormick, 1958), are based on a validity coefficient of $r = .45$ and the proportion of high rated employees to the total number of employees in the St. Louis sample, i.e., 50 per cent.

The obtained concurrent validity coefficient of $r = .46$ was significantly different from zero beyond the .01 level. This result and the expectancy charts shown in Figure 8 were considered to indicate that the test did meaningfully and to a useful extent differentiate people within this sample of shop employed blind.

For information purposes, the correlations between standard scores on the verbal section of the WAIS with the average ratings, and between the number of pegs inserted in the rate of placement use of the pegboard with the average ratings, are presented in Table 7. The intercorrelations between the tactual reconstruction pegboard, the WAIS, and the rate of placement are also presented in Table 7. A table is presented in Appendix D (Table 14) which lists each of the 52 subjects in this sample by code number with his respective average ratings and his scores on the tactual reconstruction pegboard, the WAIS, and the rate of placement.

<u>Other Findings and Observations</u>. An estimate was also obtained of the extent to which partial or remaining vision was related to scores on the test. This estimate was determined as follows. Since visual data had been obtained on each subject (by verbal report and from medical data

Table 7

Correlations Between WAIS with Ratings and Between Rate of Placement with Ratings

WAIS	r = .37
Rate of Placement	r = .44

Intercorrelations Between Tactual Reconstruction Pegboard, WAIS, and Rate of Placement

	WAIS	Rate
Reconstruction Pegboard ...	.35	.78
WAIS		.28

where available), the total sample was divided into two groups — those with no remaining vision in either eye, and those with partial vision in the better eye or in both eyes.[1] Group A, those with no remaining vision, was composed of 148 of the subjects whose visual data indicated that they were either totally blind or had, at best, only light perception. Group B was composed of 166 of the subjects whose visual data indicated that in the better eye or in both eyes they had partial vision ranging from 20/200 down to and including hand movement and/or object perception. Four subjects on which no visual data could be obtained were omitted.

[1] The form in which the visual data were collected and grouped is shown in Appendix E.

The relationship between vision and scores on the test was then estimated by computing a biserial correlation coefficient between these groups with the test scores. This resulted in an obtained biserial correlation coefficient of r = .39.

The above relationship of r = .39 between vision and test scores was siginificant and indicated that, at least in part, remaining vision was related to and/or influenced obtained scores on the tactual reconstruction pegboard. For information purposes, the mean test score for the entire sample of 314 subjects was 269.47 with a standard deviation of 84.26.

With regard to the above finding, since the test scores have an internal consistency reliability of r = .93, it is apparent that only a relatively small portion of the systematic variance associated with scores on the test is related to vision. The relationship with vision is also smaller than any of the obtained, significant validity coefficients, and this clearly indicates that some other abilities, in addition to the probable effect of vision, are contributing to the systematic variance of the criteria that have been used, of the test scores, and of the overlap between scores on the test with the criteria.

In connection with the above statement concerning vision being related to and/or contributing to the systematic variance in the criteria that have been used, the following data are pertinent. For the Chicago shop sample (N = 32), 81% of those persons rated in the high half of this group had some residual vision, whereas only 31% of the people rated in the low half had remaining vision. In the St. Louis shop sample

(N = 52), 54% of those rated in the high half of this group had some remaining vision, whereas only 31% of those rated in the low half had residual vision. The criterion groups of outside employed, shop employed and unemployed did not evidence this same tendency, considering the outside employed blind as the "high" group. For the outside employed blind (N = 84), 42% of these people had some remaining vision, whereas in the shop employed group (N = 105), 50% of the people had partial vision. In the unemployed group (N = 34), 44% of the people had partial vision.

The following observation, made and recorded in the course of administering the test to subjects, would seem worthy of mention. Several of the subjects, while taking the test, were apparently able to reconstruct some of the given configurations (particularly items 3, 4 and 5, and the practice items) only in a mirror-image or inverted form. Despite repeated instructions, these several examinees persisted in reversing or inverting the left-to-right relationship on those configurations that were not both in perfect geometric balance and located in the center of the examiner's half of the pegboard. In at least two such cases, the subjects told the examiner that they understood what was required of them. They then proceeded to correct their performance; however, before completing the particular configuration, they reverted to their original inverted procedure and even removed and relocated the pegs that had been correctly inserted. It should also be mentioned that in several of such cases, the reconstructed figure was perfect, except for the fact that it was inverted.

The above described observation would seem to have some parallel with the Bender Visual Motor Gestalt Test (Anastasi, 1954), which reportedly reveals perceptual disorders and/or brain damage. No analyses

were possible to substantiate this observation due to the lack of medical or other confirmatory data.

Another and final finding, which is only indirectly substantiated, stemmed from an inquiry into some of the dissimilarities between the results from the Chicago and St. Louis shop samples. The validity of the reconstruction task was r = .54 for the Chicago sample and r = .46 for the St. Louis sample. More noticeably, the validity coefficients for the rate of placement use of the pegboard varied from r = .19 for the Chicago sample to r = .44 for the St. Louis sample. (See Tables 6 and 7.) Also, the intercorrelations between the reconstruction task and the rate of placement varied from r = .67 for the Chicago sample to r = .78 for the St. Louis sample.

In the course of reasoning about the above discrepancies, a t test was computed on the observed difference in the mean scores on the reconstruction task between the St. Louis sample (N = 52) and all other shop employed blind (N = 53). For information purposes, the means and standard deviation for these two groups were: mean = 220.71, S.D. = 89.02 for the St. Louis sample; and mean = 246.26, S.D. = 77.28 for all other shop employed blind. The obtained value for t was t = 1.56 with 103 degrees of freedom. Such an obtained t value indicated that a mean difference of this magnitude could have occurred less than 10 times out of 100 by chance between two samples drawn at random from the same population.

A test was also computed on the difference of the intercorrelations between the reconstruction task and the rate of placement from the

St. Louis sample ($N = 52$) and all the remaining subjects on whom data had been collected on the rate of placement ($N = 212$). The intercorrelation between the reconstruction task with the rate of placement was $r = .78$ for the St. Louis sample and $r = .67$ for the remaining 212 people. The obtained value for the test on the difference between these two intercorrelations was $Z' = 1.51$ (Walker & Lev, 1953). Such an obtained value for Z' indicated that the chances were less than 7 out of 100 that two samples drawn at random from the same population would have a correlation difference of this magnitude.

A plot was then made of the standard scores on the verbal section of the WAIS from the St. Louis sample. This distribution was skewed toward the low end with a median standard score value of 50.

The above results seemed to indicate that the St. Louis sample, as a group, was not highly representative of either the total blind sample or of the other shop employed blind in the total sample. The nonrepresentativeness of the St. Louis sample seemed to evolve from the fact that, as a group, these people were poorer, several abilities considered, than the rest of the sample considered as a group.

With regard to scores on the reconstruction task, all of the above results are interpreted as suggesting the following finding. For people of low general and/or mental ability, the resulting scores on the tactual reconstruction pegboard are more influenced by manipulative ability (as opposed to tactual perceptiveness) than is true for others who are average or above average with respect to general and/or mental ability.

FACTOR ANALYSIS

The theoretical structure of the reconstruction test was investigated by performing a principal components factor analysis (Thurstone, 1947) using the Datatron computer. For this factor analysis, a 10 x 10 intercorrelation matrix was computed, using the IBM 604 Electronic Multiplier, on the data from 266 subjects for which information was available on all ten variables. The variables in the intercorrelation matrix were as follows:

(1) Item #1 of the reconstruction test

(2) Item #2 of the reconstruction test

(3) Item #3 of the reconstruction test

(4) Item #4 of the reconstruction test

(5) Item #5 of the reconstruction test

(6) Item #6 of the reconstruction test

* (7) Rate of placement score part 1

* (8) Rate of placement score part 2

(9) Standard score on the Information subtest of the WAIS

(10) Standard score on the Vocabulary subtest of the WAIS

The two rate of placement scores and the scores from the two subtests of the WAIS were included in the factor analysis in the hope that

* The rate of placement scores part 1 and part 2 refer to the number of pegs inserted in the pegboard during the first and second 30-second intervals of the total one and one-half minutes of testing time. In administering the rate of placement test to subjects, data had been recorded on the number of pegs inserted at the end of each 30-second interval.

they would lend meaning to and assist in the interpretability of any factor or factors accounting for the intercorrelations among the items on the reconstruction test. With regard to this last statement, it was felt that the two rate of placement scores could be regarded and interpreted as a pure measure of manipulative dexterity. Similarly, the two subtests from the WAIS could be regarded and interpreted as a relatively pure measure of verbal intelligence. It should be mentioned that the information and vocabulary subtests of the WAIS were specifically selected for the following reasons (Wechsler, 1955): (1) they are the two most reliable subtests in the verbal section; (2) they correlate higher with total score on the verbal section than any of the other subtests; (3) they have the largest intercorrelation of any two subtests in the verbal section. Reason (3) was especially important because it assured, in advance, that a doublet, which could be interpreted as verbal intelligence, would result from the factor analysis.

The obtained 10 x 10 intercorrelation matrix, with communality estimates entered down the main diagonal and underlined, was as shown in Table 8. The communality estimates, which were computed as part of the Datatron program, were R^2 estimates (the multiple correlation squared between the jth variable with the other n-1 variables in a matrix column) as recommended by Guttman (1956).

The factor analysis resulted in the determination of three factors. The unrotated loadings of the variables on each of the factors are given in Table 9. Also presented in Table 9 are the communalities for each variable and the communalities as estimated by the R^2 method. It can be seen,

Table 8

The 10 x 10 Matrix of Intercorrelations

with Communality Estimates

	1	2	3	4	5	6	7	8	9	10
1	.5902	.7041	.6339	.6603	.6812	.6825	.5484	.5787	.3327	.3323
2		.6889	.7138	.7243	.7291	.7518	.5427	.5583	.4280	.4100
3			.6654	.7023	.7407	.7702	.5419	.5513	.3589	.3758
4				.6880	.7434	.7691	.6181	.6098	.3984	.3860
5					.7230	.8000	.6114	.5923	.3672	.3717
6						.7692	.6402	.6473	.3687	.3814
7							.6859	.8046	.2537	.2680
8								.6894	.3176	.3136
9									.7162	.8388
10										.7111

in Table 9, that the R^2 estimates of the communalities were "good" estimates.

As the Datatron program did not result in a print-out of the final residual matrix, residual matrices (after the extraction of each of the three factors) were computed using a desk calculator. The resulting residual matrix, after all three factors were extracted, was as shown in Table 10.

Table 9

The Unrotated Factor Matrix

	I	II	III	h^2	h^2 Estimates
1	.7687	-.1053	-.0872	.6096	.5902
2	.8319	-.0264	-.1824	.7260	.6889
3	.8102	-.0824	-.1847	.6973	.6654
4	.8403	-.0804	-.0778	.7186	.6880
5	.8514	-.1157	-.1412	.7582	.7230
6	.8810	-.1322	-.1077	.8052	.7692
7	.7381	-.2286	.3858	.7459	.6859
8	.7530	-.1687	.3926	.7496	.6894
9	.5376	.6981	.0611	.7801	.7162
10	.5389	.6914	.0661	.7728	.7111

Table 10

The Final Residual Matrix
(R residual 3)

	1	2	3	4	5	6	7	8	9	10
1	-.0194	.0459	-.0137	-.0009	.0022	-.0180	-.0095	.0163	-.0018	-.0034
2		-.0372	.0039	.0090	-.0081	-.0042	-.0069	-.0010	.0103	-.0079
3			-.0319	.0005	.0153	.0256	-.0036	-.0002	-.0079	.0084
4				-.0307	.0077	.0098	.0095	-.0060	.0020	-.0061
5					-.0352	.0194	.0111	-.0129	-.0011	.0022
6						-.0361	.0013	.0039	-.0060	.0051
7							-.0600	.0587	-.0071	.0028
8								-.0602	.0066	-.0016
9									-.0638	.0624
10										-.0617

The matrix of factor loadings was then rotated orthogonally by graphic plots to simple structure using Thurstone's (1947) criterion for simple structure, i.e., the maximization of zero factor loadings. An orthogonal rotation was also performed on the Datatron computer using the varimax criterion for simple structure as recommended by Kaiser (1958), i.e., the maximization of the variance (or square of the factor loading) of each variable on a factor. The factor loadings after the graphic rotation were as presented in Table 11. The factor loadings after the rotation using the varimax criterion were as given in Table 12. It can be seen, in Tables 11 and 12, that either method of rotation resulted in factor loadings that would lead to the same general interpretation.

Table 11

The Rotated Factor Matrix

Using Thurstone's Criterion

	I	II	III	h^2
1	.79	.03	.00	.6250
2	.84	.12	-.09	.7281
3	.84	.07	-.09	.7186
4	.85	.08	.01	.7290
5	.87	.05	-.04	.7610
6	.90	.03	-.02	.8113
7	.62	-.09	.45	.5950
8	.62	-.03	.45	.5878
9	.39	.79	.10	.7862
10	.39	.78	.12	.7749

Table 12

The Rotated Factor Matrix

Using the Varimax Criterion

	I	II	III	h^2
1	.6859	.1768	.3284	.6096
2	.7674	.2650	.2586	.7260
3	.7662	.2050	.2612	.6973
4	.7311	.2269	.3643	.7186
5	.7839	.1929	.3263	.7582
6	.7935	.1913	.3730	.8052
7	.4353	.0911	.7403	.7459
8	.4276	.1526	.7372	.7496
9	.2089	.8490	.1249	.7801
10	.2090	.8437	.1315	.7728

Interpretation of the Factors. It can be seen in Tables 11 and 12 that factor I, which was a common factor, accounted for the bulk of the systematic variance among the items on the reconstruction test. That is, the reconstruction test, on this sample of the blind population, was essentially unifactorial (as had been anticipated from its high internal consistency reliability). It can also be seen in Tables 11 and 12 that variables 7 and 8, the parts of the rate of placement, had approximately twice the loading on this common factor as variables 9 and 10, the subtests of the WAIS. The latter seemed to indicate that factor

I was more of a tactual manipulative factor than an "intelligence" factor. Since it seemed unlikely that the format of the items in the reconstruction test would yield results related to verbal intelligence, it was assumed, tentatively, that the loadings of the WAIS subtests on factor I represented a general perceptiveness that was reflected in the scores on these WAIS subtests. In view of the above, factor I was tentatively labeled as "tactual manipulative perceptiveness".

Factors II and III, which were both essentially doublets and which had been built into the factor analysis by design, seemed clearly to be "verbal intelligence" and "manipulative dexterity" respectively.

With regard to the tactual reconstruction pegboard specifically, the results indicated that the test was unifactorial. Further, this single factor was a common factor involving both tactual manipulative ability and tactual and/or general perceptiveness.

DISCUSSION

In general, the obtained results indicate rather clearly that, for this sample of the blind population, scores on the tactual reconstruction pegboard are highly reliable, valid to a useful extent, and tend to be distributed in an approximately normal manner.

The obtained relationship between vision with scores on the test is not unrealistic, since, by design, remaining vision was allowed to exert its natural influence in the administration of the test. The magnitude of this relationship is not considered excessive in view of the obtained estimates of the reliability and validity of the test scores. Furthermore, as mentioned earlier, it seems most logical to allow remaining vision to exert its natural influence in the ability testing of the blind — especially since vision is apparently related, at least to some extent, with some criteria of vocational success.

The results of the factor analysis are interpreted as offering substantiation of the fact that the test scores do reflect the combination of tactual perceptiveness and manipulative dexterity, as was originally intended.

Over all, the data seem to suggest that use of the present test should prove of assistance to vocational and rehabilitation counselors in the vocational selection, placement, and counseling of the adult blind.

SUMMARY AND CONCLUSIONS

A special ability test for use with the adult blind was constructed using a pegboard format. The test was designed to yield a combined measure of tactual perceptiveness and gross manipulative dexterity. Examinees were required to reconstruct six items, which were composed of patterns or configurations of pegs, as accurately and quickly as possible. The test was administered to 318 legally blind subjects who were between the ages of 20 - 50 and who had no other major handicap in addition to blindness. In taking the test, subjects were allowed to use whatever residual vision they possessed. Performance on the test was scored on the basis of logical considerations, and this resulted in a total index score combining accuracy of reconstruction, correctness of location, and time required for reconstruction, for each item.

A distribution of total index scores for the entire sample showed that scores on the test tend to be distributed in an approximately normal manner. The relative difficulty of the items was estimated from the mean and standard deviation for each item as determined from the entire sample, and this evidenced that the test items had been presented to subjects in a general order of increasing difficulty.

The estimate of the internal consistency reliability of the test scores for the entire sample yielded an obtained coefficient of r = .93, using Hoyt's analysis of variance method for computing reliability. The obtained estimates of the validity of the test scores were r = .58 and

r = .47 between the outside employed (N = 84) combined with the unemployed (N = 34) criterion groups and between the outside employed combined with the shop employed (N = 105) criterion groups, respectively. Scores on the test did not differentiate between the shop employed and the unemployed criterion groups. The estimate of the validity of the test scores with ratings on a sample of shop employed blind from Chicago (N = 32) was r = .54. For another sample of shop employed blind from St. Louis (N = 52), the obtained estimate of the validity of the test scores with ratings was r = .46.

The relationship between remaining vision and scores on the test yielded an obtained estimate of r = .39, based on the data from 314 subjects. The magnitude of the relationship between vision with scores on the test was not considered excessive in view of the obtained estimates of the reliability and validity of the test scores for the sample and various sub-groups. Data were presented that indicate that remaining vision was related to and/or contributed to the systematic variance of some of the criteria of vocational success that were used. An observation was also discussed which suggests that several of the test items possibly reveal the presence of a perceptual disorder and/or brain damage, i.e., several subjects could reconstruct certain items only in a mirror-image or inverted form.

A principal components factor analysis was performed to investigate the theoretical structure of the reconstruction test. Included in the intercorrelation matrix were two part scores representing pure manipulative desterity and two subtests of the WAIS verbal section. The factor

analysis resulted in a single factor accounting for the systematic variance among the items of the reconstruction test. This single factor was a common factor which was composed of both tactual manipulative dexterity and tactual and/or general perceptiveness.

The following conclusions seem justified with reference to scores on the reconstruction test for the sample of the blind population tested: (1) the test scores are reliable and have demonstrated validity to a useful extent; (2) the test scores do yield a combined measure of both gross manipulative dexterity and tactual perceptiveness. It is felt that the tactual reconstruction pegboard should prove of assistance in the vocational selection, placement and counseling of the adult blind.

With regard to further research, it is recommended that normative data be collected for those occupations, filled by adult blind workers, for which the test demonstrates utility. It would also be of interest to replicate the factor analysis of the reconstruction test items using the totally blind and partially-sighted blind as separate groups.[1] The latter would establish whether or not the test scores reflect the same abilities to the same extent for these two groups.

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[1] It should be mentioned that a program is now available for the Datatron computer which will compute an intercorrelation matrix from an infinite number of punched cards. This should alleviate some of the computational labors involved in performing the suggested factor analyses.

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APPENDIX A

INSTRUCTIONS FOR ADMINISTRATION

AND

SAMPLE DATA RECORDING FORM

INSTRUCTIONS FOR ADMINISTERING THE TACTUAL RECONSTRUCTION PEGBOARD

The following instructions should be read slowly to the person taking the test. Read everything except the sentences in parentheses which tell the examiner what he should do at various points.

1. (Determine what the examinee's hand preference is.)

2. (Place the board, clear of any pegs, in front of the examinee.)

3. (Read the following.) In front of you is a board which is roughly one foot square with small holes in it. It is a pegboard. Will you please feel the board and familiarize yourself with it.

4. (While the examinee is feeling the board read the following.) Notice that either side of the board is marked by a metal strip. Also notice that there is another metal strip in the center of the board. (Allow subject time to locate this center strip.) The metal strip in the center divides the pegboard into two identical halves. On each half of the board, there are seven holes across the board in each row and 13 holes down the board in each column. (Allow subject to count the holes and verify the last statement if he desires to do so.)

5. (Move the dish of pegs to the side of the pegboard corresponding to the examinee's hand preference. Position the dish at the top of this side — so that the top edge of the dish is flush with the top of the pegboard. Read the following.) To the right (left) of the pegboard I have just placed a wooden dish containing metal pegs. (Allow subject time to locate the dish.) Will you pick up a couple of pegs and insert them into any of the holes in the pegboard. The pegs are all the same size and will fit any hole in the pegboard.

6. (After the subject has inserted a couple of pegs, read the following.) Now I am going to make a pattern or configuration with pegs on the left (right) half of the pegboard. When I have it built, I want you to feel the pattern and find out what I have made and where I have located it. Then, as soon as you are ready, I want you to reconstruct or copy my pattern on the other half of the pegboard, using the pegs that are in the wooden dish. The pattern you reconstruct should look just like mine, and it should be located, as accurately as you can, in the same holes on your half of the pegboard as my pattern.

7. (Build the first practice problem on the side of the pegboard opposite a subject's hand preference. Clear the board of any other pegs. Place the board in front of the examinee. Then

read the following.) Here is a practice problem. Find out what I have built and where I have located it. As soon as you feel ready, start reconstructing the pattern on the other half of the board. Remember to locate the pattern in the same holes on your half of the board as my pattern. You may refer to my pattern as often as you want. You may use both hands. You may pick up as many pegs at a time as you want from the wooden dish. Work as accurately and as quickly as you can and tell me when you are finished and satisfied with what you have built. (Inquire if the examinee has any questions on what he is to do. If the examinee has not started already to work on the first practice problem, tell him to start now.)

8. (Allow examinee to build first practice problem. Answer any questions that arise. When the examinee has completed the practice problem, discuss with him the accuracy of reconstruction and correctness of location, i.e., if the reconstruction is perfect, tell the examinee; if it is incorrect in any respect, point out these errors to the examinee.)

9. (Clear the board of any pegs and build the second practice problem. Then read the following.) Here is another practice problem. (Place the board in front of the examinee and make sure the dish of pegs is in place.) Go to work on it now and reconstruct it as accurately and as quickly as you can on your side of the board. As soon as you have finished, tell me that you are through.

10. (Allow examinee to build the second practice problem. Answer any questions that arise. When the examinee has completed this practice problem, discuss with him any errors in accuracy of reconstruction or location.)

11. (Inquire if the examinee has any further questions. If so, the examiner should clarify the instructions. Then read the following.) We are now ready to begin on the six configurations on which your performance will be judged. The patterns are just like the practice items you have built, except that they are in different arrangements and are composed of several more pegs. You will be timed on how quickly you complete each item; however, you concentrate on accuracy of reconstruction and correct location. As soon as you are finished and satisfied with what you have built, tell me that you are through.

12. (Clear the board of any pegs, build the first test item, and then read the following.) Here is the first pattern. When I say begin, find out what I have built and where I have built it, and then reconstruct the pattern as accurately and as quickly as you can. (Place the board in front of the examinee and make sure the dish of pegs is in place. Then read the following.) Ready. Begin now. Tell me when you are through.

(At this point, the examiner should start his stop watch. When the subject is through, stop the watch and record both the time elapsed

and the figure as reconstructed by the subject. Repeat this procedure for the remaining five items.)

<u>Note</u>: On the data recording sheet, a maximum allowable time is indicated for each item. Should a subject still be working on an item after this time has elapsed, record his performance at that point. Then suggest that effort be discontinued and the next item be attempted.

TACTUAL RECONSTRUCTION PEGBOARD

For Use With

The Adult Blind

Name: ______________________

Item No.	Raw Score	Time	Index Score
1			
2			
3			
4			
5			
6			

Total Index Score ______

Table for Converting Raw Score to Index Scores

Time		Raw Score												
Min.	Sec.	13	12	11	10	9	8	7	6	5	4	3	2	1
	15	110	102	94	85	77	68	60	51	43	34	26	17	9
	30	88	81	74	68	61	54	47	41	34	27	20	14	7
	45	79	73	67	60	54	48	42	36	30	24	18	12	6
1:	00	73	67	62	56	51	45	39	34	28	22	17	11	6
	15	70	64	59	53	48	43	37	32	27	21	16	11	5
	30	67	61	56	51	46	41	36	31	26	20	15	10	5
	45	64	59	54	49	45	40	35	30	25	20	15	10	5
2:	00	63	58	53	48	43	39	34	29	24	19	14	10	5
	15	61	56	52	47	42	38	33	28	23	19	14	9	5
	30	60	55	51	46	41	37	32	28	23	18	14	9	5
	45	59	54	50	45	40	36	32	27	23	18	14	9	5
3:	00	58	53	49	44	40	35	31	27	22	18	13	9	4
	15	57	52	48	44	39	35	31	26	22	17	13	9	4
	30	56	51	47	43	39	34	30	26	22	17	13	9	4
	45	55	51	47	43	38	34	30	26	21	17	13	9	4
4:	00	54	50	46	42	38	34	29	25	21	17	13	8	4
	15	54	50	46	42	37	33	29	25	21	17	12	8	4
	30	53	49	45	41	37	33	29	25	21	16	12	8	4
	45	53	49	45	41	37	33	29	24	20	16	12	8	4
5:	00	52	48	44	40	36	32	28	24	20	16	12	8	4
	15	52	48	44	40	36	32	28	24	20	16	12	8	4
	30	52	48	44	40	36	32	28	24	20	16	12	8	4
	45	51	47	43	39	35	32	28	24	20	16	12	8	4
6:	00	51	47	43	39	35	31	27	23	20	16	12	8	4
	15	51	47	43	39	35	31	27	23	19	16	12	8	4
	30	50	46	42	39	35	31	27	23	19	15	12	8	4
	45	50	46	42	38	35	31	27	23	19	15	12	8	4
7:	00	50	46	42	38	34	30	27	23	19	15	11	8	4
	15	49	45	42	38	34	30	27	23	19	15	11	8	4
	30	49	45	41	38	34	30	26	23	19	15	11	8	4
	45	49	45	41	37	34	30	26	22	19	15	11	8	4
8:	00	48	45	41	37	34	30	26	22	19	15	11	7	4
	15	48	45	41	37	33	30	26	22	19	15	11	7	4
	30	48	44	41	37	33	30	26	22	18	15	11	7	4
	45	48	44	40	37	33	29	26	22	18	15	11	7	4
9:	00	48	44	40	37	33	29	26	22	18	15	11	7	4
	15	47	44	40	36	33	29	25	22	18	15	11	7	4
	30	47	44	40	36	33	29	25	22	18	15	11	7	4
	45	47	43	40	36	33	29	25	22	18	14	11	7	4
10:	00	47	43	40	36	32	29	25	22	18	14	11	7	4

TACTUAL RECONSTRUCTION PEGBOARD

No. 1

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1. Accuracy Points ________
2. + 1 Point if Perfect Accuracy ________
3. - 1 Point if Any Location Error ________

RAW SCORE (Sum of 1, 2 & 3 above)	
TIME (In Minutes & Seconds)	

Maximum Time: 5 Min.

No. 2

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1. Accuracy Points ________
2. + 1 Point if Perfect Accuracy ________
3. - 1 Point if Any Location Error ________

RAW SCORE (Sum of 1, 2 & 3 above)	
TIME (In Minutes & Seconds)	

Maximum Time: 6 Min.

No. 3

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1. Accuracy Points ________
2. + 1 Point if Perfect Accuracy ________
3. - 1 Point if Any Location Error ________

RAW SCORES (Sum of 1, 2 & 3 above)	
TIME (In Minutes & Seconds)	

Maximum Time: 10 Min.

No. 4

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.  X  X  .  .  X  .
.  X  .  .  X  X  .
.  .  .  X  X  X  .
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1. Accuracy Points ________
2. + 1 Point if Perfect Accuracy ________
3. - 1 Point if Any Location Error ________

RAW SCORE (Sum of 1, 2 & 3 above)	
TIME (In Minutes & Seconds)	

Maximum Time: 7 Min.

No. 5

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.  X  X  X  X  .  .
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1. Accuracy Points ________
2. + 1 Point if Perfect Accuracy ________
3. - 1 Point if Any Location Error ________

RAW SCORE (Sum of 1, 2 & 3 above)	
TIME (In Minutes & Seconds	

Maximum Time: 6 Min.

No. 6

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1. Accuracy Points ________
2. + 1 Point if Perfect Accuracy ________
3. - 1 Point if Any Location Error ________

RAW SCORE (Sum of 1, 2 & 3 above)	
TIME (In Minutes & Seconds)	

Maximum Time: 10 Min.

APPENDIX B

INSTRUCTIONS FOR SCORING

WITH EXAMPLES

INSTRUCTIONS FOR SCORING WITH EXAMPLES

The following instructions pertain to the scoring of the taotual reconstruction pegboard test items. It is assumed that a record is available for each item of both the configuration as reconstructed by an examinee and the time required for the reconstruction. (See suggested data recording form, Appendix A.)

A person's performance on each test item is scored on the basis of (1) accuracy of reconstruction, (2) correctness of location, and (3) time required. "Accuracy of reconstruction" refers to the shape of the configuration or the relationship between pegs. "Location" refers to where, on the examinee's half of the pegboard, the entire reconstructed configuration is located with reference to the given pattern (or actual test item). It is possible for a subject to reconstruct accurately a given item but not locate the configuration in the same position on the board as the given configuration. "Time" refers to the minutes and seconds elapsed starting with the presentation of the pattern to the subject and ending when the subject informs the examiner that he is through.

For accuracy of reconstruction, a subject is given as many points as he places pegs in the correct relationship to one another. Thus, if an item oonsists of a total of eight pegs, and a subject places seven pegs in the board in the correct relationship to one another (with reference to the given pattern), the item is scored giving seven points for accuracy. If an item is reconstructed perfectly (all pegs in the correct relationship to one another), the subject is given one additional point

for this perfect accuracy. It should be noted that accuracy of reconstruction is judged independently of where the entire figure is located; hence, a subject may receive the one additional point for perfect reconstruction even if his reconstruction is not correctly located. In establishing the points for accuracy of reconstruction, if a subject places more pegs in the board than the total number of pegs involved in the item, the difference, between the number of pegs inserted and the total number required by the item, is subtracted from the subject's accuracy score determined in the above manner. With regard to the latter, if a subject reconstructed perfectly an item containing a total of eight pegs, but he inserted and left in the board ten pegs when he was finished, two points (the difference between ten and eight) are subtracted from his accuracy score. Since he receives eight points for accuracy, and two points are subtracted for the extra pegs, his final accuracy score is six points. In this situation, no additional point would be given for perfect reconstruction.

The correctness of location is scored by merely subtracting one point from a subject's accuracy points if the configuration is incorrectly located, regardless of the magnitude of the incorrect location. As shown both in the examples that follow and in the sample data recording sheet in Appendix A, a person's raw score on each item is the sum of his accuracy points, plus one point for perfect accuracy, minus one point for an incorrect location.

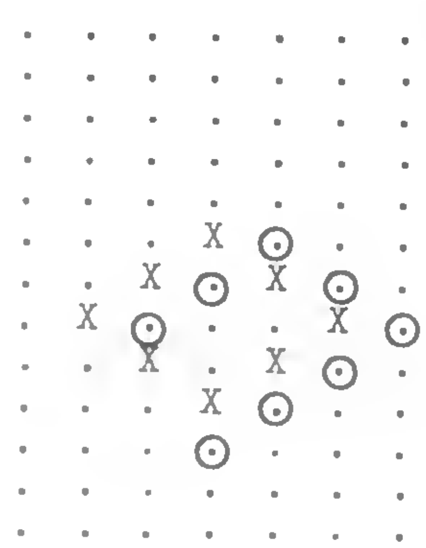
A person's index score for each item is then determined from his raw score and the time associated with this raw score using the conversion

table presented both in Table 1 and with the sample data recording sheet in Appendix A. The index score for an item is read from the conversion table as the value at the intercept of the raw score with its associated time in minutes and seconds. A person's total score on the tactual reconstruction pegboard is then determined by summing the index scores for the six items.

With regard to the intervals represented by the time column in the conversion table, each time value represents those times from 1/2-second greater than the preceeding, shorter time value to 1/2-second greater than the particular value. For example, "30-seconds" covers those elapsed time periods from 15.5-seconds to 30.5-seconds. Similarly, "1:00-minute" represents those times from 45.5-seconds to 60.5-seconds (or one minute and .5-second).

The following step-by-step example illustrates the above scoring procedure. In the example, the typewritten "X's" show the item as

No. 2



1. Accuracy Points 7

2. + 1 Point if Perfect Accuracy 0

3. - 1 Point if Any Location Error -1

RAW SCORE (Sum of 1, 2 & 3 above)	6
TIME (In Minutes & Seconds)	3:10

Maximum Time: 6 Min.

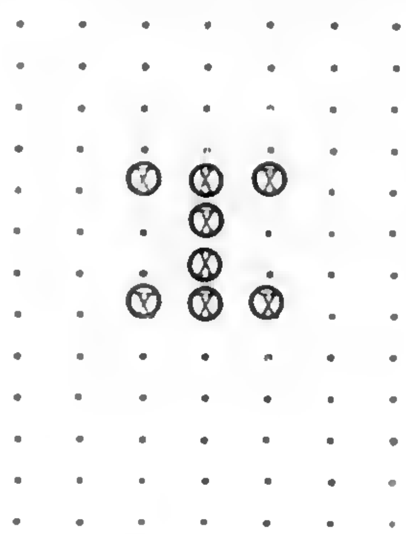
presented to the subject. The circles represent the item as reconstructed by the subject. Since the subject has placed seven pegs in the correct relationship to one another, he receives seven points for accuracy. No point is awarded for perfect accuracy. As the entire reconstructed figure is offset to the right with regard to location, one point is subtracted for this incorrect location. The subject's raw score is thus six (seven, plus zero, minus one). Going to the conversion table, the point at which a raw score of six and a time of 3-minutes and 10-seconds intercept has a value of 26 — the time of 3-minutes and 10-seconds falls in the interval represented by 3:15. Thus, 26 is the person's index score on this item.

The following pages contain scored examples of each of the test items. In each example, the circles represent the item as reconstructed by an examinee. The examples present the scoring for each item in the case of perfect reconstruction (pages 81-82) and in two cases of imperfect reconstruction. The cases of imperfect reconstruction are representative of the more frequent errors made by people who have been tested.

It should also be mentioned that in those cases where a subject reconstructs a given pattern in mirror-image or inverted form, the scoring is the same as above; however, the reconstructed figure is evaluated for accuracy of reconstruction and correctness of location as if the given pattern were inverted. No points are subtracted because the figure is inverted. Whether or not a subject is reconstructing a test item in this manner is generally readily evident to the examiner observing the subject at work. The example of item #5 on page 86 illustrates a case where the configuration was reconstructed in inverted form.

TACTUAL RECONSTRUCTION PEGBOARD

No. 1

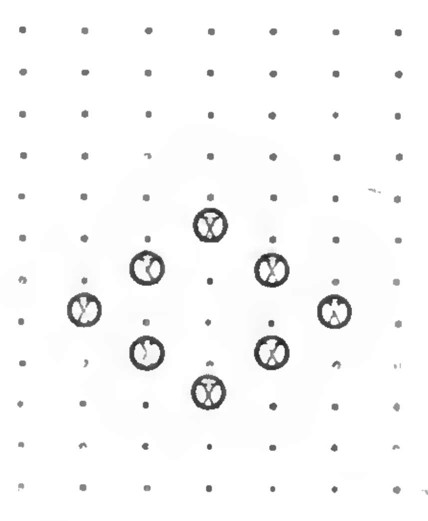


1. Accuracy Points 8
2. + 1 Point if Perfect Accuracy +1
3. - 1 Point if Any Location Error 0

RAW SCORE (Sum of 1, 2 & 3 above)	9
TIME (In Minutes & Seconds)	

Maximum Time: 5 Min.

No. 2

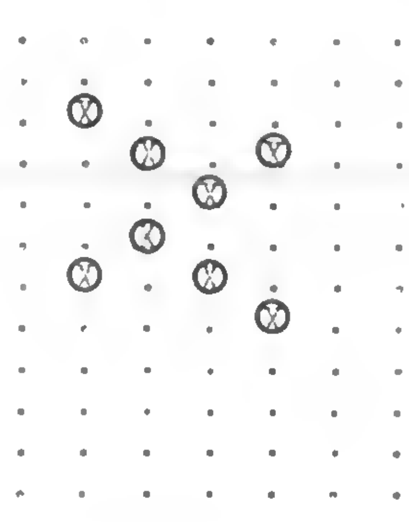


1. Accuracy Points 8
2. + 1 Point if Perfect Accuracy +1
3. - 1 Point if Any Location Error 0

RAW SCORE (Sum of 1, 2 & 3 above)	9
TIME (In Minutes & Seconds)	

Maximum Time: 6 Min.

No. 3

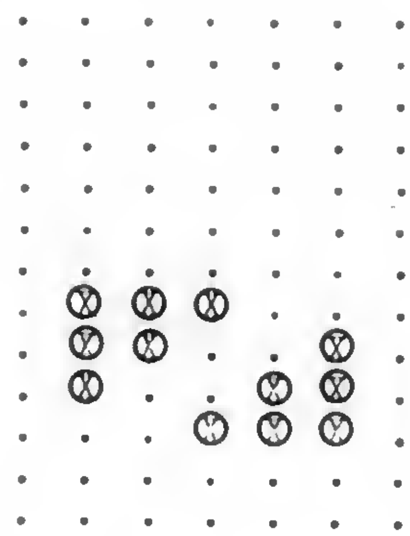


1. Accuracy Points 8
2. + 1 Point if Perfect Accuracy +1
3. - 1 Point if Any Location Error 0

RAW SCORES (Sum of 1, 2 & 3 above)	9
TIME (In Minutes & Seconds)	

Maximum Time: 10 Min.

No. 4

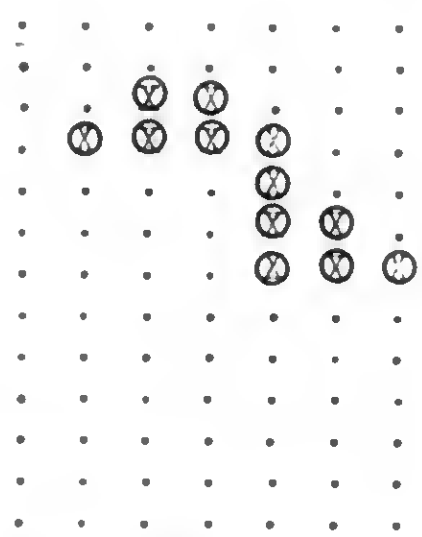


1. Accuracy Points 12
2. + 1 Point if Perfect Accuracy +1
3. - 1 Point if Any Location Error 0

RAW SCORE (Sum of 1, 2 & 3 above)	13
TIME (In Minutes & Seconds)	

Maximum Time: 7 Min.

No. 5

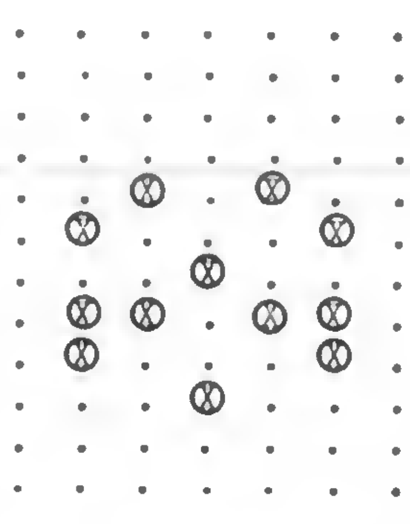


1. Accuracy Points 12
2. + 1 Point if Perfect Accuracy +1
3. - 1 Point if Any Location Error 0

RAW SCORE (Sum of 1, 2 & 3 above)	13
TIME (In Minutes & Seconds	

Maximum Time: 6 Min.

No. 6



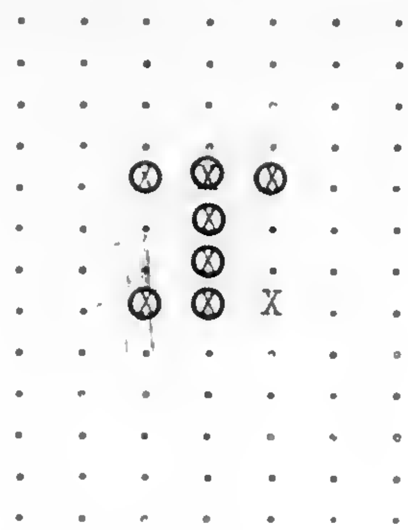
1. Accuracy Points 12
2. + 1 Point if Perfect Accuracy +1
3. - 1 Point if Any Location Error 0

RAW SCORE (Sum of 1, 2 & 3 above)	13
TIME (In Minutes & Seconds)	

Maximum Time: 10 Min.

TACTUAL RECONSTRUCTION PEGBOARD

No. 1

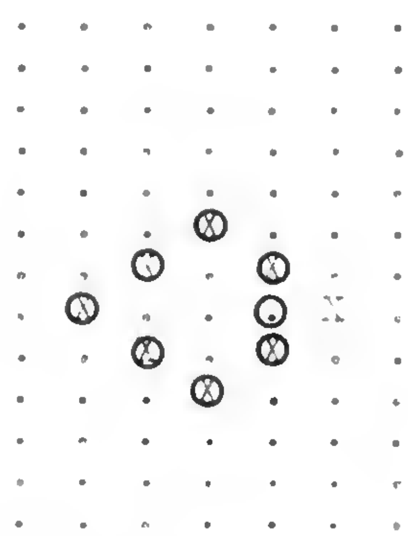


1. Accuracy Points 7
2. + 1 Point if Perfect Accuracy 0
3. - 1 Point if Any Location Error 0

RAW SCORE (Sum of 1, 2 & 3 above)	7
TIME (In Minutes & Seconds)	

Maximum Time: 5 Min.

No. 2

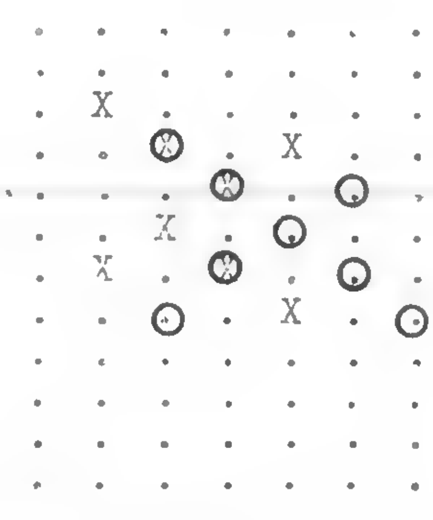


1. Accuracy Points 7
2. + 1 Point if Perfect Accuracy 0
3. - 1 Point if Any Location Error 0

RAW SCORE (Sum of 1, 2 & 3 above)	7
TIME (In Minutes & Seconds)	

Maximum Time: 6 Min.

No. 3

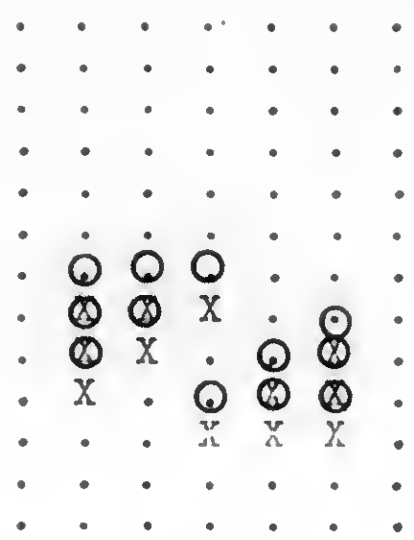


1. Accuracy Points 6
2. + 1 Point if Perfect Accuracy 0
3. - 1 Point if Any Location Error -1

RAW SCORES (Sum of 1, 2 & 3 above)	5
TIME (In Minutes & Seconds)	

Maximum Time: 10 Min.

No. 4

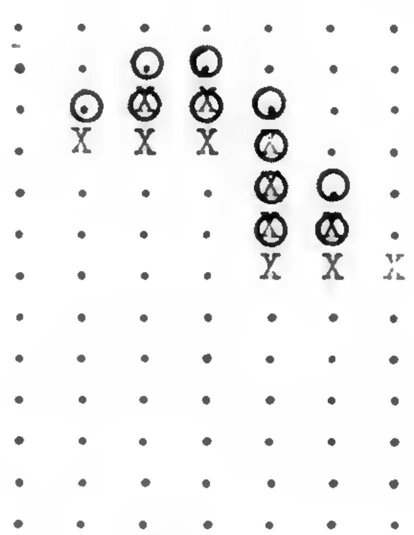


1. Accuracy Points 12
2. + 1 Point if Perfect Accuracy +1
3. - 1 Point if Any Location Error -1

RAW SCORE (Sum of 1, 2 & 3 above)	12
TIME (In Minutes & Seconds)	

Maximum Time: 7 Min.

No. 5

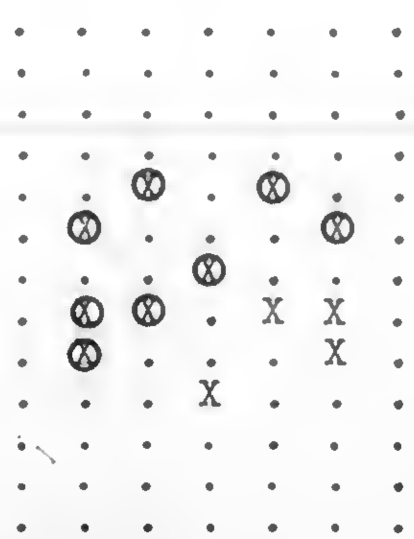


1. Accuracy Points 11
2. + 1 Point if Perfect Accuracy 0
3. - 1 Point if Any Location Error -1

RAW SCORE (Sum of 1, 2 & 3 above)	10
TIME (In Minutes & Seconds	

Maximum Time: 6 Min.

No. 6



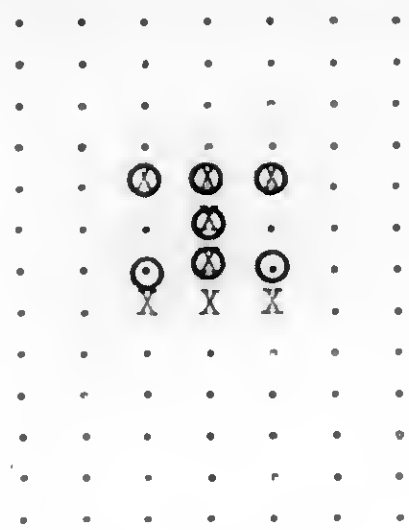
1. Accuracy Points 8
2. + 1 Point if Perfect Accuracy 0
3. - 1 Point if Any Location Error 0

RAW SCORE (Sum of 1, 2 & 3 above)	8
TIME (In Minutes & Seconds)	

Maximum Time: 10 Min.

TACTUAL RECONSTRUCTION PEGBOARD

No. 1

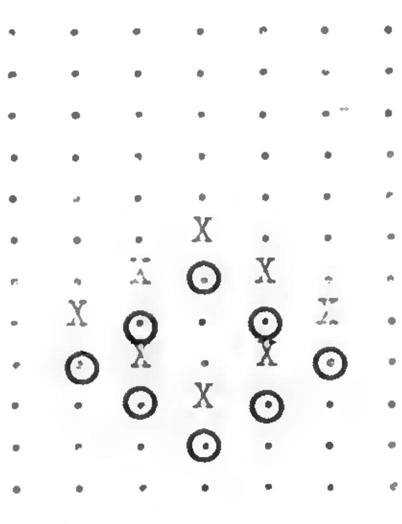


1. Accuracy Points 5
2. + 1 Point if Perfect Accuracy 0
3. - 1 Point if Any Location Error 0

RAW SCORE (Sum of 1, 2 & 3 above)	5
TIME (In Minutes & Seconds)	

Maximum Time: 5 Min.

No. 2

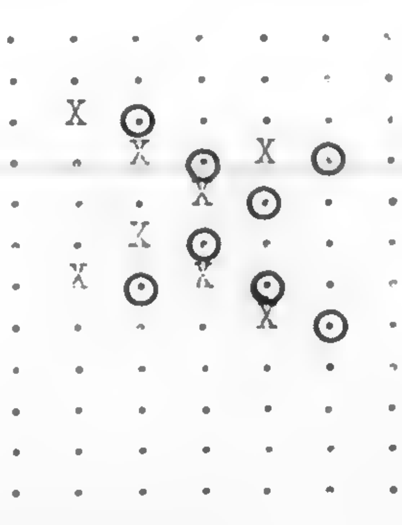


1. Accuracy Points 8
2. + 1 Point if Perfect Accuracy +1
3. - 1 Point if Any Location Error -1

RAW SCORE (Sum of 1, 2 & 3 above)	8
TIME (In Minutes & Seconds)	

Maximum Time: 6 Min.

No. 3

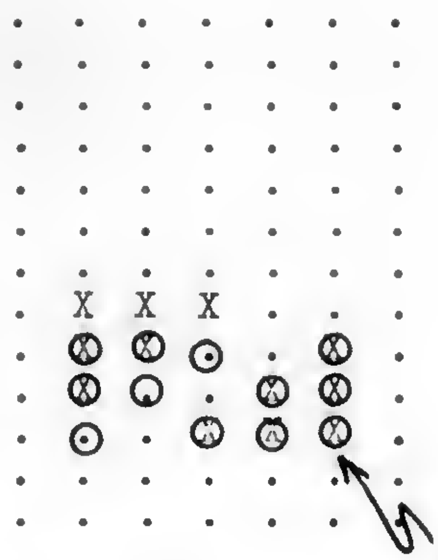


1. Accuracy Points 8
2. + 1 Point if Perfect Accuracy +1
3. - 1 Point if Any Location Error -1

RAW SCORES (Sum of 1, 2 & 3 above)	8
TIME (In Minutes & Seconds)	

Maximum Time: 10 Min.

No. 4



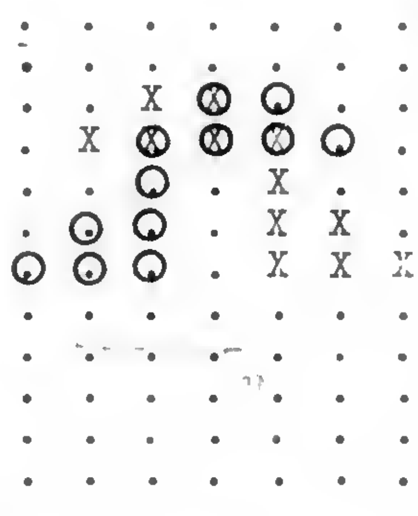
START

1. Accuracy Points	9
2. + 1 Point if Perfect Accuracy	0
3. - 1 Point if Any Location Error	0

RAW SCORE (Sum of 1, 2 & 3 above)	9
TIME (In Minutes & Seconds)	

Maximum Time: 7 Min.

No. 5



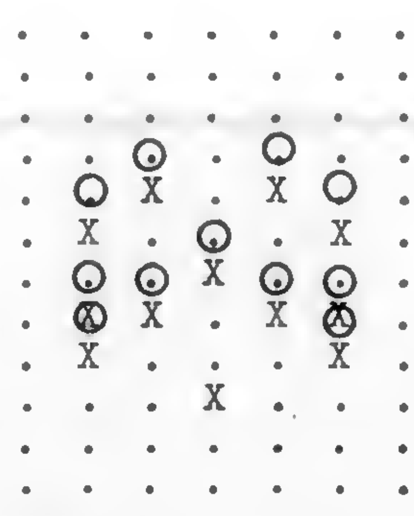
MIRROR IMAGE

1. Accuracy Points	12
2. + 1 Point if Perfect Accuracy	+1
3. - 1 Point if Any Location Error	0

RAW SCORE (Sum of 1, 2 & 3 above)	13
TIME (In Minutes & Seconds	

Maximum Time: 6 Min.

No. 6



1. Accuracy Points	11
2. + 1 Point if Perfect Accuracy	0
3. - 1 Point if Any Location Error	-1

RAW SCORE (Sum of 1, 2 & 3 above)	10
TIME (In Minutes & Seconds)	

Maximum Time: 10 Min.

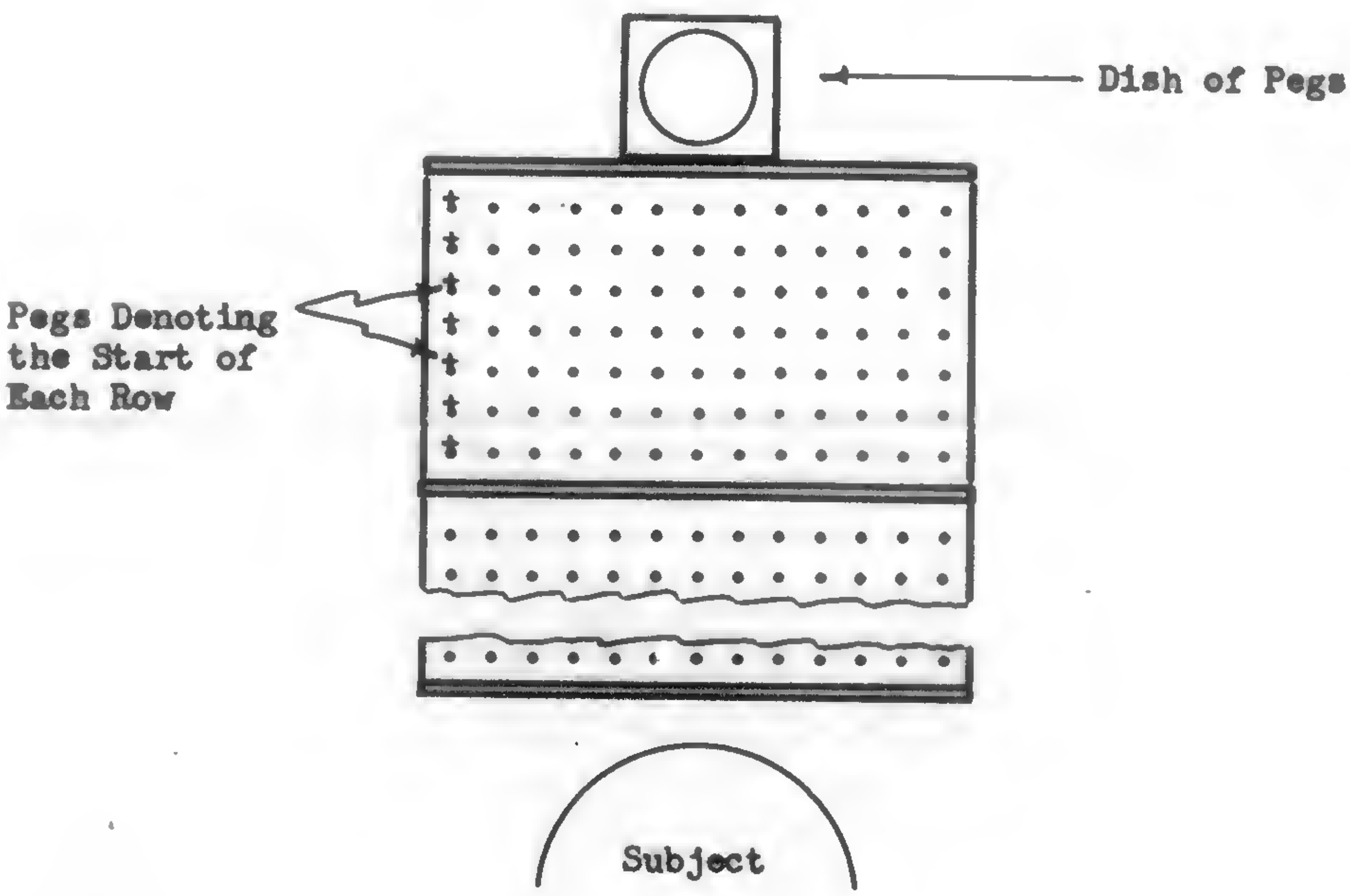
APPENDIX C

INSTRUCTIONS FOR USING THE PEGBOARD TO OBTAIN A MEASURE OF RATE OF PLACEMENT

INSTRUCTIONS FOR USING THE PEGBOARD TO OBTAIN A MEASURE OF RATE OF PLACEMENT

The tactual reconstruction pegboard can also be used to yield a measure of rate of placement. This measure consists of the number of pegs that an examinee can insert in the board during a 1 1/2-minute time period. At the end of this section, standardized verbal instructions for administration and a suggested data recording form are presented.

The pegboard is used in the following manner to obtain a measure of rate of placement. Position the pegboard in front of the examinee so that the metal strips defining the sides of the board become the top and bottom of the pegboard (see figure below). Place one peg in the first, left-hand hole of the top seven rows. These pegs identify the



start of each row. Place the wooden dish, containing the metal pegs, at the top, in the center, and flush against the pegboard (as shown in the figure). The pegboard is now ready for use in obtaining the rate of placement measure.

The examinee is first allowed to familiarize himself with the pegboard. He is told that he may use both hands in this task; however, only one hand (his preferred hand) may be used to pick up and insert pegs. He is also told that he may pick up only one peg at a time, and that he is to work across the rows starting with the top row. For practice, the examinee is allowed to fill the first row. The pegs are then removed (except for those identifying the beginning of each row), and the examinee is then told to place as many pegs in the board as he can until the examiner says to stop. The total number of pegs inserted during a 1 1/2-minute time period is a subject's rate of placement score.

INSTRUCTIONS FOR ADMINISTRATION

The following instructions should be read slowly to the person taking the test. Read everything except the sentences in parentheses which tell the examiner what he should do at various points.

1. (Determine what the examinee's hand preference is.)

2. (Place the board, with one peg inserted to denote the start of each of the top seven rows, in front of the examinee.)

3. (Read the following.) In front of you is a board which is roughly one foot square with small holes in it. It is a pegboard. Will you please feel the board and familiarize yourself with it.

4. (While the examinee is feeling the board, read the following.) Notice that both the top and bottom of the board are marked by a metal strip. There is another metal strip which divides the top and bottom seven rows of the board. You will be using only the top part of the pegboard. Notice also that the first, left-hand hole of each of the top rows is marked by a peg. There are twelve empty holes in each of the top rows. (Allow examinee time to note these things.) At the top of the board there is a wooden dish which contains metal pegs just like the ones already in the board. (After subject locates the dish of pegs, read the following.) Will you pick up a couple of pegs and insert them into any of the holes in the pegboard. The pegs are all the same size and will fit any hole in the pegboard.

5. (After the subject has inserted a couple of pegs, read the following.) In this test I am interested in how quickly you can place pegs in the holes on the board. In putting the pegs in the holes, you are to work across each row, starting at the top. When you finish one row, continue on to the next row, starting again at the left. Also, in taking the pegs from the dish, you are to pick up only one peg at a time. After you have inserted the peg, you may then get another from the dish. You are to use your right (left — whichever is preferred) hand in picking up and inserting the pegs. You may use your other hand as a guide for the holes and to remember where you are working. In other words, I want you to place the pegs as quickly as you can, but pick up only one peg at a time from the dish.

6. (Inquire if the examinee has any questions and clarify any misunderstanding. Then read the following.) For practice, will you now fill in the top row of the board.

7. (When the examinee has filled the top row, again inquire if there are any questions. If not, remove the pegs inserted in the top row

by the examinee and read the following.) I have removed the practice pegs you inserted in the top row. I will tell you when to start, and when I say begin, you place as many pegs in the board as you can until I say stop. Start with the top row, and remember, take only one peg at a time from the dish. If some pegs should spill, or if you drop a peg, disregard this and keep right on working until I say stop. You will have only a short period in which to work, so place the pegs as quickly as you can. Are you ready? .... Begin now. (At this point the examiner should start his stop watch. When one and one-half minutes have elapsed, tell the subject to stop. Record the total number of pegs inserted by the examinee.)

SUGGESTED DATA RECORDING FORM

The form presented below can be used to record a subject's performance on the rate of placement. Any holes skipped or omitted can be indicated by an "X". The last hole in which the examinee inserted a peg can be indicated by a circle. The typewritten "O's" indicate the peg identifying the beginning of each row.

<u>Rate of Placement (1 1/2 minutes)</u>

O	+	+	+	+	+	+	+	+	+	+	+	+
O	+	+	+	+	+	+	+	+	+	+	+	+
O	+	+	+	+	+	+	+	+	+	+	+	+
O	+	+	+	+	+	+	+	+	+	+	+	+
O	+	+	+	+	+	+	+	+	+	+	+	+
O	+	+	+	+	+	+	+	+	+	+	+	+
O	+	+	+	+	+	+	+	+	+	+	+	+

If desired, part scores can be obtained by noting what point the examinee has reached at the end of each 30-second interval (or any time interval that may be of interest).

APPENDIX D

TABLES 13 AND 14

Table 13

Ratings and Test Scores for Chicago Sample

(N=32)

Code No.	Total Rating	Reconstruction Pegboard Index Score	Rate of Placement	WAIS Verbal Standard Score
01	201	114	29	26
02	240	231	35	65
03	166	271	46	31
04	181	234	38	38
05	173	239	31	60
06	247	313	36	63
07	186	219	43	63
08	228	126	26	60
09	210	272	47	62
10	183	227	35	54
11	152	193	28	40
12	249	246	33	67
13	255	279	34	51
14	190	273	37	49
15	213	261	33	64
16	143	117	34	38
17	219	191	29	71
18	170	229	29	55
19	230	255	49	59
20	220	266	40	65
21	205	251	36	56
22	237	264	34	38
23	221	249	31	52
24	251	292	37	88
25	172	232	38	56
26	172	188	38	43
27	125	101	24	44
28	240	269	38	47
29	147	165	30	67
30	194	241	41	73
31	187	100	12	55
32	189	285	42	81

Table 14

Ratings and Test Scores for St. Louis Samples

(N=52)

Code No.	Average Rating	Reconstruction Pegboard Index Score	Rate of Placement	WAIS Verbal Standard Score
01	35	206	31	67
02	36	143	30	42
03	37	147	25	36
04	37	110	23	33
05	39	088	13	*
06	40	204	43	48
07	41	165	26	23
08	41	110	28	43
09	42	098	20	43
10	42	321	40	52
11	42	167	36	36
12	43	115	30	40
13	44	312	34	54
14	45	198	33	71
15	45	306	32	63
16	46	299	41	32
17	46	447	45	16
18	47	182	31	51
19	47	188	32	50
20	48	095	24	49
21	49	133	18	52
22	49	147	20	45
23	48	144	21	40
24	49	263	39	57
25	49	160	32	66
26	49	221	37	77
27	50	149	26	30
28	50	112	25	45
29	50	314	48	46
30	50	138	35	31
31	51	273	25	68
32	53	216	31	55
33	53	306	41	77
34	53	180	33	56
35	54	067	-30	33

* Data not available

Table 14 (Continued)

Code No.	Average Rating	Reconstruction Pegboard Index Score	Rate of Placement	WAIS Verbal Standard Score
36	54	295	40	98
37	54	200	35	47
38	55	325	34	75
39	57	379	49	85
40	57	295	40	58
41	58	258	32	65
42	58	188	30	69
43	58	401	43	40
44	58	350	44	72
45	59	242	40	33
46	60	328	42	54
47	60	268	31	48
48	61	215	34	50
49	63	290	37	64
50	65	256	39	77
51	66	208	40	49
52	75	373	43	67

APPENDIX E

FORM IN WHICH VISUAL DATA

WERE COLLECTED AND GROUPED

FORM IN WHICH VISUAL DATA WERE COLLECTED AND GROUPED

Visual Data:
Right Eye ____________ Left Eye ____________

Right Eye

Acuity	% loss
___ 20/200	
___ 17-19/200	
___ 20/210-230	___(1) 80-90%
___ 14-16/200	
___ 20/240-280	
___ 12-13/200	
___ 20/290-320	___(2) 91-96%
___ 11-12/200	
___ 20/330-380	
___ 7-10/200	
___ 20/390-600	___(3) 97-99%
___ H. M.	
___ O. P.	
___ L. P.	___(4) L. P.
___ T. B.	___(5) T. B.
	___(6) No data

Left Eye

Acuity	% loss
___ 20/200	
___ 17-19/200	
___ 20 /210-230	___(1) 80-90%
___ 14-16/200	
___ 20/240-280	
___ 12-13/200	
___ 20/290-320	___(2) 91-96%
___ 11-12/200	
___ 20/330-380	
___ 7-10/200	
___ 20/390-600	___(3) 97-99%
___ H. M.	
___ O. P.	
___ L. P.	___(4) L. P.
___ T. B.	___(5) T. B.
	___(6) No data

The sample was divided into two groups, representing those with no remaining vision and those with partial vision, in the following manner. Those people whose vision in the better eye or in both eyes placed them

in categories 4 and 5 above were combined into one group representing those with no remaining vision. Those people whose vision in the better eye or in both eyes placed them in categories 1, 2 and 3 were combined into a second group representing those with partial vision.

VITA

VITA

Gruber, Alin.

Date and Place of Birth

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Education

A. B., 1953. Dartmouth College

M. S., 1957. Purdue University

Ph. D., Candidate for, 1959. Purdue University

Experience

Graduate Teaching Assistant in Psychology, Purdue University, January 1956 to May 1957.

Graduate Research Assistant in Psychology, Purdue University, September 1957 to May 1959.

Research Associate, Dunlap and Associates, Inc., Stamford, Conn. Summers 1957 and 1958.

Military Service

Engineering Officer, Department Head, U.S. Navy June 1953 to July 1955.

Organizations

Sigma Xi

Midwestern Psychological Association

American Psychological Association (Associate)